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SYMPATHECTOMY IN RAYNAUD'S DISEASE, ERYTHROMELALGIA, AND OTHER VASCULAR DISEASES OF THE EXTREMITIES[1]

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SURGERY is now in the midst of a period of enthusiasm over operative procedures directed toward the sympathetic nervous system. A voluminous literature deals with the practical results of periarterial sympathectomy in a wide variety of diseases; but in particular, those in vascular and trophic lesions of the extremities. Because of the paucity of our knowledge of the anatomy and physiology of the sympathetic nervous system, there is necessarily a mass of empirical clinical data. It follows that our knowledge of the rôle of the sympathetic system in pathological conditions is likewise meagre. Our attention was first directed to the peripheral effects of sympathectomy in an experimental and clinical study of the results produced in spastic diseases of the extremities by removal of the sympathetic trunks, their rami and ganglia. We wish to record our experiences and impressions obtained in removing the influence of the sympathetic innervation to an extremity in Raynaud's disease, erythromelalgia, and other vascular diseases of the extremities.

ANATOMY AND PHYSIOLOGY

It would seem fundamental to have clearly in mind in just what manner the blood vessels of the extremities receive their innervation. The physiological work of the nineteenth century brought out the now commonly accepted fact that the muscular action of the blood vessel walls is under the control of the sympathetic nervous system.

It will be remembered that the sympathetic nervous system is composed of a craniosacral and a thoracicolumbar outflow. These two portions differ from one another anatomically, physiologically, and in their reactions to the administration of drugs. The craniosacral outflow has received the name "parasympathetic" in contradistinction to the thoracicolumbar division which has been termed the "sympathetic" division. We are concerned with the thoracicolumbar outflow of fibers. Within the intermediolateral cell column of the anterior horn of grey matter in the thoracic and lumbar portions of the spinal cord are found the cells of origin of the fibers of this division of the sympathetic nervous system. These fibers leave the spinal cord through the anterior or motor roots and reach the sympathetic ganglia situated paravertebrally. Here they end to form a synapsis with the dendrites of a sympathetic ganglion cell. These small myelinated fibers constitute the preganglionic sympathetic nerve fibers and make up the white rami communicantes. From the sympathetic ganglion fibers arise which join the spinal nerves. These post-ganglionic fibers are unmyelinated and form the grey rami communicantes. Some of these post-ganglionic fibers proceed directly to the structures which they innervate, while the majority join the spinal nerves.

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It will be seen that as far as our knowledge now goes the sympathetic nervous system is purely an efferent one. The possibility of antidromic *afferent* conduction will be spoken of later.

The vessels of the extremities receive a sympathetic innervation through the somatic nerves and this supply is received at regular segmental levels. In addition there may be a direct supply from the sympathetic ganglion cells by a fine plexus of fibers within the sheath of the arteries. The question of the existence and importance of these two types of innervation has been a mooted one for many years. Kramer and Todd (15) studied the distribution of the vasomotor nerves to the arm and Potts (22) made a similar study upon the leg. In both instances the conclusions were identical; that the nerve fibers are supplied to the blood vessels at regular levels in their course and that only a small number of fibers accompany the large arteries to end in the arterioles and capillaries. Langley (17) stimulated the lumbar sympathetic chain before and after section of the femoral and sciatic nerves. Pallor of the foot was obtained before cutting these nerves and was abolished after section. He also injected ergotoxine and then stimulated the lumbar sympathetic chain. Upon the side of the cut peripheral nerves there was no effect while flushing occurred upon the opposite side. He concluded that the vascular sympathetic fibers run to the trunk and limbs by the somatic spinal nerves and not by way of the arteries.

Milko (20) stimulated the sheath of the femoral artery in dogs and secured no changes in volume of the leg. However, vasodilatation was obtained after the sciatic nerve was severed. Schilf (24) secured no increase in the cannulated blood flow in dogs upon stimulation of the sheath of the femoral artery. Bowing (2) made plethysmographic studies upon the dog's leg and found that all of the vasomotor reflexes are maintained after periarterial sympathectomy and are abolished by interrupting the mixed peripheral nerves. He stated that the fibers for these vascular reflexes do not accompany the vessels but join them only upon reaching the periphery. Wiedkopf (27) has shown that anæsthesia of the brachial plexus in man produces the same changes in the arm as does removal of the sympathetic chain. These effects cannot be obtained by removing the adventitia of the vessels. Denning (8) sectioned the femoral nerve below Poupart's ligament and the sciatic nerve in the middle of the thigh in dogs. He then exposed the femoral artery and vein and drew a rubber tube beneath them. He ligated the extremity *en masse* without including the vessels. After these procedures he injected barium chloride into the tibial artery. Contrary to the normal results there was no painful reaction. He concluded that the sensory nerves of vessels of the lower extremity run with the spinal nerves. Joris (14) has insisted upon the presence of a perivascular nerve plexus which anastomoses along the entire length of the vessel. He described the presence of sympathetic ganglion cells within this perivascular plexus. Diaz (9) states that these are not true ganglion cells but are entirely different from sympathetic ganglion cells in their structure and size. He states that they are similar to those cells found in the sinusoidal node and in the wall of the auricle of the heart. Guillaume (11) has carried out very careful microscopic dissections of the larger vessels of the extremities. He believes that stripping the wall of an artery does not completely remove the innervation to that vessel. He states that removing this adventitia over a small length of the vessel cannot possibly interrupt fibers going to the rest of the extremity. This author admits that there is a fine plexus of fibers in the sheath of the peripheral arteries, which divides into innumerable branches; but strongly emphasizes that the majority of the vascular innervation comes to the vessels in a segmental distribution from the spinal nerves. In this connection it is interesting to note that in median nerve lesions Crile (7) has recently called attention to the development of cyanosis, accurately delimited to the cutaneous area supplied by the median nerve, following the application of the cuff of a sphygmomanometer to the arm and inflation to equal the patient's diastolic blood pressure. This phenomenon disappeared as evidences of regeneration of the nerve appeared.

From a study of the literature on the subject it would appear then that there can be no question that the peripheral vessels receive their major sympathetic innervation by a segmental distribution from the spinal nerves and that these fibers originate from the sympathetic ganglia of the thoracicolumbar division as post-ganglionic fibers. There is a serious doubt as to the presence of a sympathetic innervation in the adventitia of the vessel which continues throughout its course. It would be difficult to conceive of how under such circumstances the removal of a small portion of the vessel adventitia could affect the caliber of the vessel at a distance. However, we must take into consideration the reports of hyperæmia and temperature changes produced in the hands and feet of patients after such an arterial decortication.

In 1913, Leriche (19) called attention to the results he had obtained in man by thoroughly removing the periarterial sympathetic fibers about the femoral artery. He called particular attention to an hyperæmia produced by vasodilatation and to an increased warmth of the extremity undoubtedly produced by the same mechanism. Leriche reported the beneficial and curative effects of such a procedure in many clinical entities. He was quite unable, however, to verify these findings upon experimental animals. Nevertheless Leriche has stated that in man the predominating vasomotor influences are carried by the perivascular sympathetic nerves.

In considering the clinical results obtained by supposedly interrupting the sympathetic supply to the blood vessels, one is immediately struck by this complete absence of any basic experimental physiologic work upon which the beneficial results may be explained. Certainly nowhere is there any experimental confirmation of Leriche's statement that in man the predominant vasomotor impulses are carried in sympathetic fibers found in the blood vessel adventitia.

Callander (4) found no rise in the systolic blood pressure in man after arterial decortication and in only one case could he find an increase in temperature in the operated upon extremity. Lehman (18) working upon animals could not corroborate the findings of vasodilatation, increase in blood pressure or temperature in the limb operated upon. He also denied any beneficial effect of arterial sympathectomy upon wound healing. Bowing's and Wiedkopf's (2, 27) plethysmographic studies upon animals failed to confirm any of the reported results following periarterial sympathectomy. Elving (10) directly examined the capillaries following decortication of the vessel walls. He noted improvement of the circulation in four cases; a decrease in two, and no change in six. Any of these results may be explained by Sherrington's work in which he demonstrated that freshly excised arteries show different diameters under the same wall tension when they have no sympathetic connections. Mosser and Taylor (21) performed an arterial decortication upon ten cats and five dogs. In only two did they find an appreciable temperature increase.

This experimental work merely confirmed Langley's statement that all vasomotor impulses leave the spinal cord by way of the white rami, reach the sympathetic ganglia, are relayed through the grey rami to the spinal nerves, and thus reach their peripheral destination. It came to be believed that dilatation of arteries is produced only by paralysis of the normal vasoconstrictor fibers which have their origin in the sympathetic ganglion cells.

In 1874 Goltz sectioned the sciatic nerve and obtained a vasodilatation and a rise in temperature in the corresponding limb. Tewaschew (26) obtained similar results after cutting the femoral nerve and the opposite effects upon stimulation of the peripheral end of the divided nerve. Taylor and Rice (25) and Mosser and Taylor (21) have uniformly obtained an increase in the temperature of an extremity following an alcoholic injection of the sciatic nerve with a strong enough solution to produce a paralysis. They found that the minimum concentration necessary to produce paralysis produces a maximum hyperthermia.

Severance of the posterior root of the trigeminal nerve very commonly produces a vasodilatation and an increase in temperature upon the affected side. This is an observation we have made in many cases following posterior root section for the relief of trigeminal neuralgia. These results may be explained

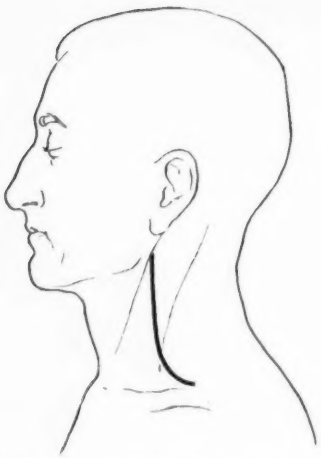

Fig. 1. Skin incision employed to isolate and remove cervical sympathetic trunk.

upon the work of Bayliss and Bruce who have demonstrated the existence of vasodilator impulses which travel antidromically along a sensory nerve fiber. It would seem therefore certain that vasodilatation with its accompanying phenomena in an extremity is not entirely dependent upon the periarterial sympathetic innervation and it is probable that there is very little dependent upon any such innervation of the blood vessel wall. On the other hand it appears equally as definite that these phenomena are regularly obtained through the agency of both purely motor, sensory or mixed nerves of cerebrospinal origin. However, it must not be forgotten that clinical observations are on record in which removal of the vessel adventitia has produced an increase in the local temperature, hyperæmia, and a change in the nutrition of the tissues. After removal of the cervical and lumbar sympathetic chains in patients who have had spastic extremities, we have recorded a definite vasodilatation and hyperæmia, noted particularly in the sclera of the eye and in the skin of the extremity. In addition, there has been an accompanying elevation in the surface temperature of from 1.0 to 1.5 degrees. We have also recorded the fact that these effects are transient and disappear from within one to two weeks when the normal relations are re-established. We have observed a hyperæmia and dilatation of the vessels of the sclera and nictitating membrane in cats following removal of the superior cervical sympathetic ganglion and chain but have found no corresponding increase in the surface temperature. The animal's furry protection may of course explain the lack or non-development of a regulatory skin vasomotor mechanism. These observations should not be lost sight of and attempts must be made to supply their explanation.

For our part, we can understand how removal of the sympathetic ganglia or interruption of their rami communicantes might produce whatever physiological results are to be found in the entire extremity. On the other hand in view of the known anatomical and physiological facts, we cannot conceive of how the interruption of the minor portion of the vascular sympathetic innervation from a local segment of an artery can affect the most distal portions of the extremity.

In the consideration of vascular diseases of the extremities with symptoms and signs of deranged circulation, it is necessary to take into account the physiology and pathology of the capillary system. From the work of Hooker (12), Krogh (16), Rouget (23), and others it is believed that the capillaries are definitely capable of active alterations in their caliber. From this experimental work it is evident that these structures are controlled by nerve impulses and by direct mechanical and chemical stimuli. It has been shown that stimulation of the sympathetic innervation produces an active capillary constriction. On the other hand, stimulation of sensory spinal nerves results in a capillary dilatation through the mechanism of an antidromic conduction in these fibers. In a study of dermatographia, Cotton, Slade and Lewis (6) have shown the effects of mechanical irritation of the skin, which they believed were due to capillary constriction or dilatation. According to the recent views of Krogh (16), Hooker and Dale (13), the capillaries are influenced by chemical stimuli. It has been shown that histamine, for example, produces a marked capillary dilatation. Cannon (5) has presented evidence that in wound shock, the capillaries are

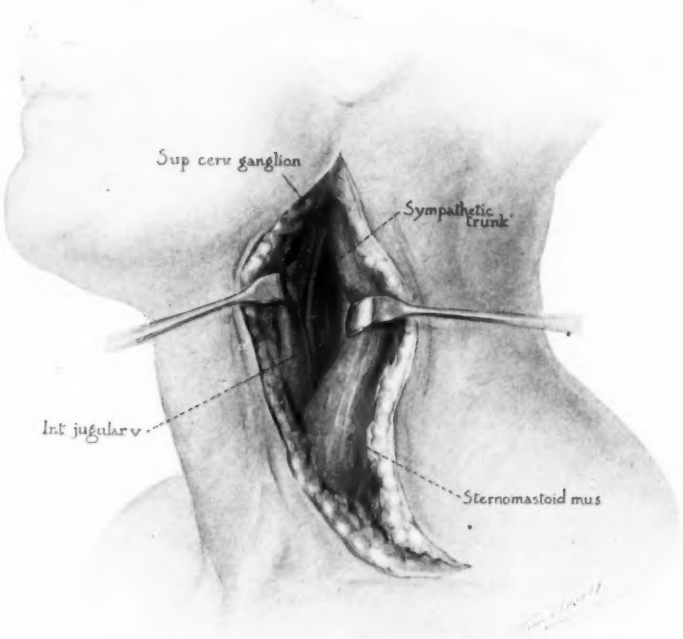

Fig. 2. Position of cervical sympathetic trunk lying beneath the lateral edge of the internal jugular vein.

packed with red cells, which indicates the presence of a chemical influence.

Further, we must not lose sight of other physiological factors which may play a very prominent part in the interpretation of circulatory diseases of the extremities. We cannot deny the influences of the frequency and force of the cardiac action; the viscosity of the blood; the quantity of the blood; the changes in the circulation of the blood under various conditions and the changes in cardiac muscle work. As a result we must recognize the apparent inadequacy of any surgical procedure in which an attempt is made to alter peripheral vascular resistance to affect materially the clinical course of such diseases.

Consequently, basing our surgical procedures entirely upon known anatomical and physiological facts, we have attempted to record our observations in vascular diseases of the extremities after removal of the sympathetic ganglia and their rami. This principle of attack to our mind removes the major sympathetic innervation to an extremity without in the least impairing the somatic nerve supply. We believe that any surgical attack upon the sympathetic system may be applied only to those diseases of the extremities in which organic lesions of the vessels cannot be demonstrated. It is illogical to attempt to produce changes in muscular contractility in the walls of vessels in which definite pathological changes have taken place. Therefore, we should exclude thrombo-angiitis obliterans, arteriosclerosis, luetic arteritis, and possibly scleroderma and chronic asphyxia. While many authors deny their recognition as clinical entities, we may include erythromelalgia, Raynaud's disease, and acroparæsthesia as diseases suitable for surgical attack. The symptomatology in these conditions has been referred to disturbances in the entire sympa-

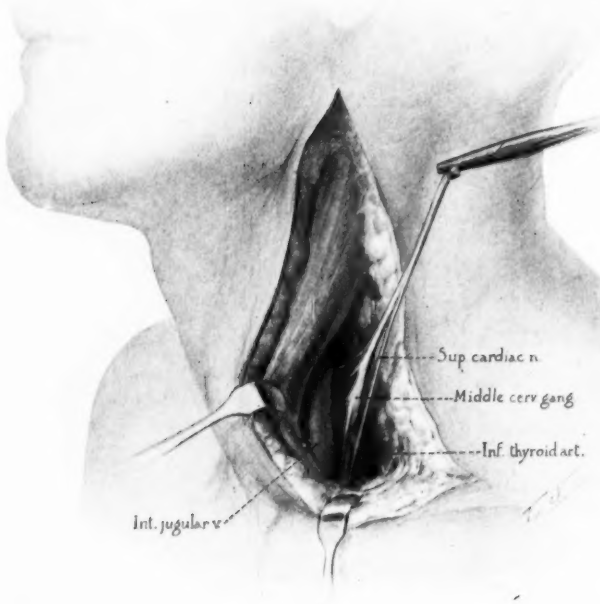

Fig. 3. Relation of the middle cervical sympathetic ganglion to the inferior thyroid artery.

thetic nervous system and the importance of the relationship of the endocrine glands has been emphasized by some individuals.

SURGICAL PROCEDURES

In operations upon those patients in whom the symptoms involved the upper extremities, we removed the stellate and inferior sympathetic ganglia, their branches, and the intervening trunk. From one of these patients we removed the superior and middle ganglia in addition. We feel that this is quite unnecessary since the nerves of the upper extremity receive their sympathetic fibers entirely from the stellate ganglion. In addition we add the symptoms of a Horner's syndrome unwarrantedly. In dealing with lesions in the lower extremity we have removed the lumbar sympathetic ganglia both by a lumbar and an intra-abdominal route. We prefer the former if we desire to produce an effect in only one extremity and the latter if we wish to remove the sympathetic supply from both extremities during one operation.

TECHNIQUE OF CERVICAL SYMPATHECTOMY

An incision is made from the inferior angle of the mandible and on the medial edge of the sternomastoid muscle downward. The line of incision crosses the sternomastoid from its medial to its lateral edge in an oblique direction to reach the superior border of the clavicle. Here the incision turns lateralward. The completed line therefore resembles a hockey stick (Fig. 1).

The fascia of the sternomastoid is exposed and the medial edge of the muscle is freed. If one desires to excise the superior cervical ganglion, the incision should be carried upward toward the tip of the mastoid process. The carotid artery, jugular vein, and vagus nerve are now in the field of operation as the medial edge of the sternomastoid muscle is retracted laterally. By gently retracting the

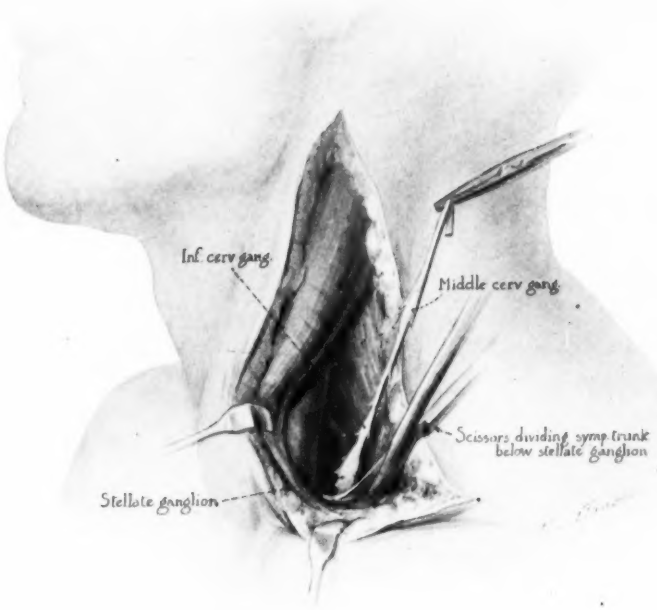

Fig. 4. Retraction upward and laterally brings the stellate ganglion into view and its rami may be easily severed.

jugular vein medially and at the same time rolling its posterior surface forward, the cervical sympathetic chain may be seen lying beneath the lateral edge of the vein on the scalenus muscle (Fig. 2). By dissecting upon the medial edge of the sternomastoid, any danger of injuring the spinal accessory nerve is avoided. The sympathetic trunk may be isolated by blunt dissection and followed as it passes laterally and downward beneath the sternomastoid muscle. If any difficulty is experienced in recognizing the sympathetic trunk, one may dissect upward and identify the superior cervical ganglion and proceed from that landmark. The trunk may be divided and passed beneath the muscle and delivered into the field by gentle outward and upward traction. At the same time the lateral and inferior edge of the sternomastoid is retracted medially. In this position the inferior thyroid artery passes transversely across the field from its origin from the thyreocervical axis. The middle cervical sympathetic ganglion is usually in close association with this vessel and may encircle it. Medial laryngeal branches as well as the superior and middle cardiac nerves arise from the sympathetic trunk near this ganglion (Fig. 3). The chain is then followed further inferiorly behind and below the clavicle. The apical pleura soon enters the field and should be protected. As one bluntly dissects downward the trunk must not be confused with the cardiac nerves which are almost of equal size. The parent trunk holds a more posterior position. The next structure encountered before reaching the stellate ganglion is the small inferior cervical ganglion. This may be fused with the stellate and if separate, lies immediately superior to the latter. At this point the vertebral artery may be seen in the field lying medially. By exerting gentle traction upward and outward during this dissection and dividing the rami from the trunk and ganglia, the

stellate ganglion may be delivered into the field from its location on the tubercle of the first rib. This maneuver makes the removal much more simple. After dividing its rami, the sympathetic trunk is divided below the ganglion (Fig. 4).

The subcutaneous tissue and skin are closed in the usual fashion and a pad is bandaged into position to fit snugly into the supraclavicular fossa. It will be recognized that this procedure may be modified as one desires to excise the stellate ganglion only or others of the ganglia and trunk. It is recognized that the upper extremity receives its sympathetic innervation from the stellate ganglion alone.

TECHNIQUE OF SYMPATHECTOMY BY THE ABDOMINAL ROUTE

A midline incision is made through the skin, fascia, and peritoneum with the umbilicus about opposite the middle point. With the patient in the Trendelenburg position, the intestines are packed upward and laterally to expose clearly the posterior peritoneal wall. The aorta, vena cava, and ureters may be seen through the peritoneum.

A linear incision is made through the peritoneum over the medial edge of the psoas muscle (Fig. 5). This does not expose the ureter. The lumbar sympathetic trunk and ganglia lie upon the anterolateral surfaces of the vertebral bodies and are partially covered by the medial edge of the psoas and on the right side by the vena cava (Fig. 6). Because of the situation of the vena cava the right lumbar chain is more difficult to expose. The vena cava is gently retracted medially and at the same time is lifted up. The sympathetic ganglia and trunk may be seen clearly, lying in a loose adventitious tissue. The trunk and ganglia bear a varying relation to the lumbar arteries and veins, in that these structures may pass above or below the trunk (Fig. 7). The second lumbar ganglion usually lies just under cover of the inferior edge of the third portion of the duodenum. We have carried our excision upward to include this ganglion and have removed the chain as low as to include the fourth lumbar ganglion. This structure occasionally lies over the brim of the pelvis, and it is necessary to protect carefully the iliac vessels. Any oozing encountered is easily controlled. We have never sutured the peritoneum, but simply allow it to fall into place. The aorta does not overlie the trunk as does the vena cava, and it is therefore much easier to remove the chain and ganglia upon the left side. The intestines are replaced and the wound is closed in the usual manner.

In this work we have removed the ganglia and trunk from the second to the fourth lumbar ganglia inclusive. It necessarily follows that the communicating rami are severed as their ganglion cells of origin are removed. This abdominal route of approach permits one to interrupt the sympathetic supply to both lower extremities through the same operative wound.

TECHNIQUE OF SYMPATHECTOMY BY THE LUMBAR ROUTE

This method of approach was first devised by Royle. A complete detailed description of this operation is given by this author in SURGERY, GYNECOLOGY AND OBSTETRICS, 1924, xxxix, 707. We have followed this same technique and havé found it to be quite satisfactory. This operation is particularly useful and is indicated if one desires to remove the sympathetic supply from one extremity only. We have found it a trifle more difficult to remove the entire chain and ganglia from the second to the fourth lumbar ganglia inclusive by this method. The procedure is also rather difficult in large muscular or obese individuals. These small technical inconveniences are outweighed, however, by the smooth postoperative convalescence of patients who have been operated upon by this method as compared to those operated upon by the abdominal route.

CLINICAL CASES

Erythromelalgia—Lumbar Sympathectomy—Relief

In 1922, P. C., aged 35, a Russian-Jewish tailor, began to have an aching pain in his feet, particularly after walking. This difficulty increased in frequency and intensity so that upon his entrance into the hospital walking four or five blocks caused him great discomfort and pain. Since 1924, he had noticed that his feet, and particularly his toes, became very red and purplish in color. This was true when they were in a dependent position. This color disappeared if he elevated his feet. The redness of his toes and the dorsum of his foot was almost always confined to

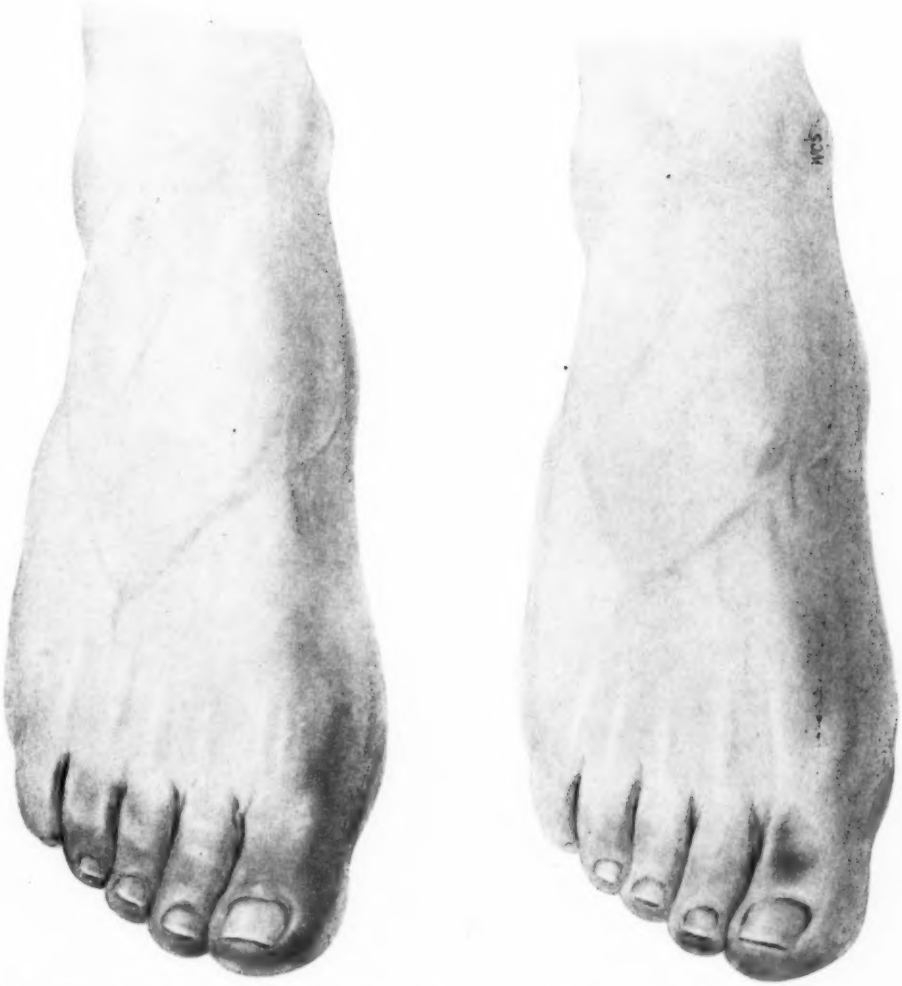

Plate II. Right foot of patient with erythromelalgia before and after removal of right lumbar sympathetic chain and ganglia.

Sympathectomy in Raynaud's Disease, Erythromelalgia, and Other Vascular Diseases of the Extremities.—Loyal Davis and Allen B. Kanavel.

the area in which he experienced pain. Accompanying these symptoms the patient also complained of swelling and a feeling of fullness in his feet. The past and family history were without significance.

Examination. The pulses of both legs and feet were full and easily palpable. X-ray examination of the extremities showed an entire absence of vessel wall calcification. A marked hyperæsthesia was present over the dorsal surfaces of both feet. This corresponded to the color changes which were present. It was noted that the toes and the dorsal surfaces of both feet as high as the metatarsotarsal articulations became intensely red in color if the patient allowed the feet to become dependent. This color was also brought out by exertion or by heat. The color could be made to disappear by digital pressure but rapidly returned when the pressure was released. Elevation of the feet caused the redness to disappear. The color changes occurred paroxysmally and were accompanied by pain.

No trophic lesions such as blebs, thickening, or atrophy of the skin were seen. The nails of the second and fourth toes on the right foot were brittle and longitudinally striated. These symptoms were all symmetrical in both feet but were more pronounced upon the right side. The remainder of the physical and neurologic examination was without note.

Blood chemistry examination showed a non-protein nitrogen of 45.1 milligrams; urea nitrogen of 14.8 milligrams; creatinine 1.39 milligrams; and sugar of 0.127 per cent. The red blood cell count was 4,080,000; white cells 8,400; hæmoglobin 80 per cent. All urine examinations were negative.

Operation. A *right* lumbar sympathectomy was performed April 29, 1925. The entire right sympathetic chain from the second to the fourth lumbar ganglia inclusive was removed. The innervation to the left extremity was not disturbed.

Postoperative course. April 30, 1925: The right lower leg is 1.5 degrees warmer than the left. The toes are reddish-purple in color. The color change is similar to that seen when the leg is pendent, although it is now present as the patient lies in bed. No pain is present. The left foot is normal in color.

May 1, 1925: Increase in surface temperature of the right leg persists as does the red color when the foot is supported.

May 10, 1925: Patient allowed out of bed. Right foot is still red in color but not painful in pendent position. Left foot became red and distinctly painful after a short walk in the corridor; the right foot was not painful and the color remained the same.

May 18, 1925: Patient returned for examination. Still has increased surface temperature in the right foot though this is distinctly less than when examined upon prior occasions. The right foot is still red in color regardless of its position. He has had no pain in this foot even after a considerable amount of exercise.

The patient returned to his work as a tailor in Rochester, New York. He has communicated with us and has been seen upon several occasions by Dr. George Whipple. The patient's report is given in abstract as to his subjective symptoms.

June 1, 1925: "My right foot is assuming its natural color and feels warmer than the left. I have had no pain in the right foot."

June 17, 1925: "There are a few little red spots on my right foot and it gives me a little burning pain. However, I am back at work."

June 29, 1925: "I am feeling fine. The trouble in the right foot has disappeared and I have no pain at all."

October 12, 1925: "My right foot is its natural color and I have no pain in it at all even after walking. My left foot is always cold and it gives me pain once in a while."

February 18, 1926: "My right foot is still in fine condition and feels warm to my touch. It does not change in color as it did and I have no pain in it."

The condition of this patient's foot is shown both before and after operation in Plate II. The last sketch was made in December of 1925 by Mr. N. C. Jacobs, of the Department of Anatomy, University of Rochester Medical School.

The most striking symptoms in this case were the redness and pain occurring in paroxysmal attacks and influenced by posture, heat, and exertion. These symptoms were localized symmetrically in the distal portions of the extremities, although the right foot was more seriously affected. There was an absence of all evidence of organic vascular disease. This undoubtedly was a case of erythromelalgia. The arterial pulsations, paroxysmal attacks, and absence of intermittent claudication differentiate it from thrombo-angiitis obliterans, with which it may be confused. Cassirier has divided this condition into two types: (1) that in which the local symptoms follow the paths of certain nerves and (2) that in which the distribution is diffuse over various peripheral parts of the extremities. In the first group, he states that an irritative process in the peripheral nerves exists with predilection for the vasodilator and secretory fibers. In the second group he believes that a central nerve lesion is present and that in all probability the sympathetic system is the seat of the disease. No pathological evidence is offered for this latter statement.

There seems to be no doubt that after a year the patient's condition is definitely improved. We expect to operate upon the other extremity at the patient's convenience but at this time it serves as an excellent control for the experiment.

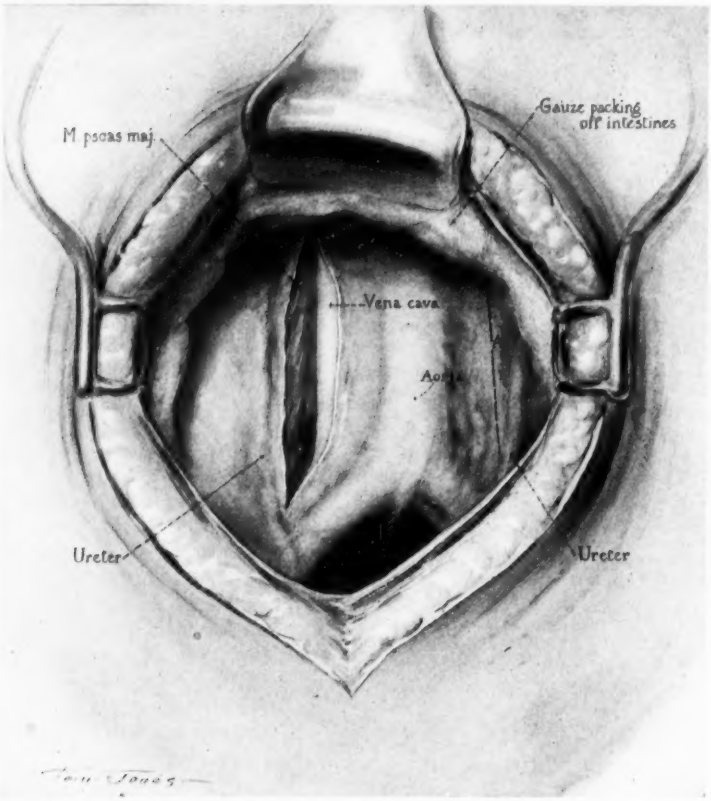

Fig. 5. Incision through the posterior peritoneal wall over the medial edge of the psoas muscle.

Raynaud's Disease—Right Cervical Sympathectomy —Relief

E. W., aged 28, a Polish housewife, first noted in 1918 that the middle finger on her right hand would become pale and blue in color when she was out in the cold weather or when she had her hands in cold water. This color change was always accompanied by severe pain and numbness and tingling in the finger. During the following 6 years these symptoms gradually progressed to involve the other fingers and the thumb of the right hand. The patient then noticed that excitement or worry would produce the same symptoms and under such conditions her face would become deeply flushed. In 1924, this same group of symptoms appeared in the fingers of the left hand. The pain in her hands had been very severe and she had sought relief in many ways without success.

The patient also stated that she very commonly had ulcerated areas on the ends of her fingers which followed the slightest trauma. The healing of these lesions was always followed by retracted scars. During the past year the patient had been complaining of pain in the toes of both feet accompanied by a slight bluish discoloration. The past history was without note and no relation could be drawn with her present condition.

Examination. The patient's face is of a dark reddish purple color particularly when she is under observation. Her skin is naturally dark in color. There is a bilateral exophthalmos. The thyroid gland is palpable but not abnormally enlarged. There are no bruits or thrills over it. Blood pressure is 120:68; pulse 88.

By placing the hands in cold water or by surprising the patient, an attack of discoloration of the fingers can be produced. Normally the hands are perhaps slightly redder in color than those of the average individual. During an attack the color rapidly changes to a bluish-gray. This involves all of the fingers and thumb down to the metacarpophalangeal joints except the fifth fingers which

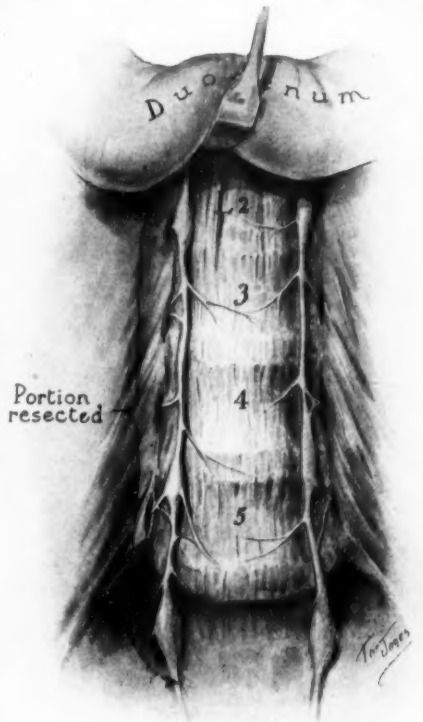

Fig. 6. Relation of the lumbar sympathetic trunk to the psoas muscle and vena cava.

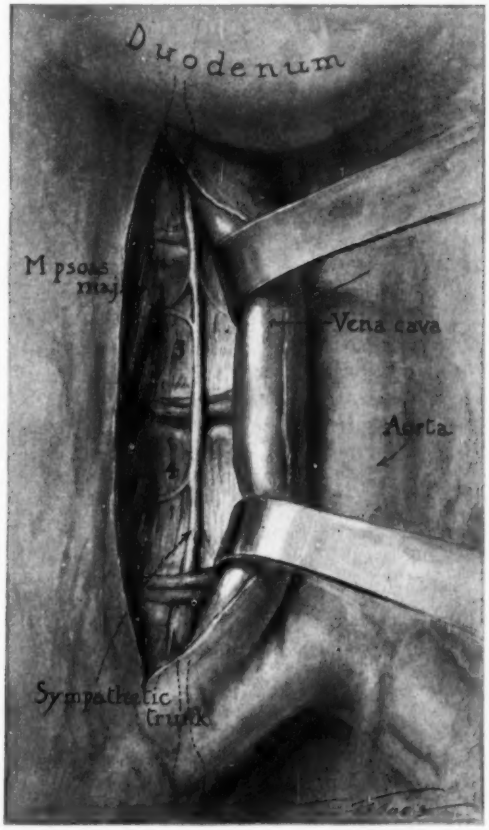

Fig. 7. Relation of the lumbar sympathetic trunk to the bodies of the vertebra. This shows the retraction of the third portion of the duodenum necessary to expose the second lumbar ganglion.

become discolored only over the distal phalanges. During this attack the radial pulse is full and strong. The fingers feel cold and clammy. They are very tender to the slightest pressure, particularly over the extremities. The tips of the fingers and thumbs are hard and boardlike and are very painful at all times but more so during an attack. The skin in these areas is scaly and indurated. The tip of the right index finger is ulcerated. The end of the distal phalanx is exposed. This has been in this condition for 5 weeks and resulted from a rather insignificant trauma. All of the peripheral pulses could be palpated with ease.

A tourniquet was applied to both arms but no hyperæmia could be produced after its release. X-ray plates of the arms showed no evidence of vessel calcification. X-ray plates of the hands did not show an atrophy in the tips of the distal phalanges characteristic of Raynaud's disease in the later stages.

The basal metabolic rate of the patient upon several occasions was plus 12. Blood chemistry examination showed non-protein nitrogen of 27.4 milligrams; uric acid 4.24 milligrams; creatinine 1.5 milligrams, and sugar 0.11 per cent. The blood and urine examinations were normal.

Operation. On January 29, 1926, a right cervical sympathectomy was performed. Since we were anxious to leave no possible sympathetic innervation to the upper extremity from the cervical chain, we removed the entire chain and all of the ganglia from the superior to the stellate inclusive. Naturally, all of the rami of the latter were severed. Again, we will simply remove the stellate ganglion because we feel that this structure contains all of the cells of origin of fibers innervating the upper extremity.

Postoperative course. The patient made an uneventful recovery from her operation. No sensory findings were present about the face or neck. We may state here that in none of our cases have we

found any subjective or objective sensory disturbances in the face or neck following a sympathectomy. There is an enophthalmos, small pupil, narrow palpebral fissure, and the scleral vessels are dilated upon the right side. It will be remembered that the patient had an indolent ulcer on the index finger of her right hand when she came into the hospital. We removed the dressing and simply allowed the finger to be exposed without in any way treating the lesion.

February 4, 1926: The patient has had no pain and no attacks of local syncope and asphyxia since her operation. The right index finger is entirely healed and the skin of the tip of the finger is pink. The right upper extremity has been from one to two degrees warmer than the left since her operation. The patient states that the examiner's hands are colder when felt with her right hand as compared with her left. No difference in the color of the fingers or hands can be detected except during an attack.

February 7, 1926: The temperature difference is less today as measured with a surface thermometer. The patient's hands were immersed in ice cold water today. After 15 minutes no change had occurred in either hand. As soon as they were brought into the air the attack of syncope and asphyxia began. The change in color to the typical chalky bluish-white blanching occurred quickly in both hands. However, the extent of the color change and the degree of change were quite different in the right hand. The ends of the thumb and fingers, except the right fifth finger, were involved only over the middle and distal phalanges as contrasted to the condition in the left hand in which the changes extended into the palm of the hand. Further, the return to the normal color of the right hand was completed 5 minutes before that in the left.

March 4, 1926: The patient was taken to the artist for a colored sketch of her hands. Before entering the presence of this stranger, her hands were normal in color. Immediately upon meeting him she began to develop an attack of local syncope and asphyxia. The result of this attack which lasted 30 minutes is seen in Plate I. She returned upon several occasions in order that this color might be verified and it was not until the third visit that the change did not occur and cold water immersion was necessary.

March 21, 1926: The patient notes a great difference in the condition of her right hand. She has had no paræsthesia or pain and her hand never feels as cold as the left nor as it did previously. The lesion of the right index finger has never recurred. The Horner's syndrome on the right side has remained unchanged.

April 6, 1926: The patient has had no pain in her right hand. During an attack, the middle finger of the right hand becomes cyanotic from the tip to the proximal interphalangeal joint while the rest of the fingers and hand are normal in color. The left hand becomes markedly blue and painful. There has been a decided improvement since the time represented in Plate I.

The occurrence of induration in the tips of this patient's fingers suggests, of course, scleroderma. Since vasomotor changes may be early manifestations of scleroderma this condition may be difficult to differentiate from Raynaud's disease. Buerger quotes Cassirier as grouping Raynaud's disease into three types: The typical cases show symmetrical gangrene, dystrophic changes in the distal portions of the extremities, with thickening of the skin, and immobilization of the tendon sheaths and joints. The second group comprises the cases in which local asphyxia and syncope initiate the disease. There is no progression into a state of gangrene but on the other hand a chronic stage of vasomotor, sensory, and sclerodermic symptoms occurs. The last group consists of rare cases which show vasomotor symptoms in the presence of an advanced scleroderma. Our case obviously belongs to the second group. Certainly it belongs to the group of vasomotor neuroses of which the Raynaud syndrome is an example. Buerger (3) believes that in these cases there is an irritative or perhaps a paralytic process in the vasomotor system. Cassirier believes that the vasoconstrictors are in a condition of increased irritability.

Adson and Brown (1) have reported a case of Raynaud's disease in which they removed the lumbar sympathetic chain and stripped the adventitia from the external iliac vessel upon the same side. They have reported a marked improvement in the extremity upon the side operated upon. They believe that such a double procedure prolongs the physiological effects of removal of the sympathetic innervation.

While time has not elapsed following the operation equal to that in the first instance, we feel that this patient has received definite improvement and relief.

We have operated upon another patient with Raynaud's disease and removed the stellate ganglion upon the right side. This patient suffered from local syncope and asphyxia in all four extremities but the symptoms were more advanced in the hands. Thickening of the skin and immobilization of the tendon sheaths and joints of the hands were present. This patient was operated upon so recently that we have had no opportunity to determine accurately just what her postoperative status is. Consequently

we refrain from including a detailed history of her case.

Thrombo-Angiitis Obliterans—Lumbar Sympathectomy—No Relief. Observation of a Second Case after Periarterial Sympathectomy Elsewhere—No Relief

We also wish to record our experience with sympathectomy in this disease and because of the clinical failure we refrain from giving a detailed report.

We removed the right lumbar sympathetic trunk and ganglia from a patient whom we believed had an erythromelalgia. The red color of this man's extremities was intensified in the dependent position but a fact to which we did not give sufficient weight was that this color was not paroxysmal but was constantly present. He had a trophic ulcer upon the end of his great toe on the right foot and all but his dorsalis pedis vessels pulsated. X-ray plates of the extremity failed to show any calcification in the vessels. The pain persisted, as did the color changes in the foot and after 2 months no improvement whatever was evident. Because of the intense pain which persisted and because of an advancing gangrene, an amputation was performed. Examination of the vessels showed the organic changes of a thrombo-angiitis obliterans.

We have observed a second example of this disease which was verified by an examination following amputation of the extremity. A periarterial sympathectomy had been performed elsewhere 9 months previously. The patient complained bitterly of pain in his foot and required morphine for relief. The color changes in his toes and foot were typical of those seen in the preceding case. However, no gangrene had developed although no pulsation could be felt in any of the peripheral vessels.

We made a diagnostic error in the first of these cases of thrombo-angiitis obliterans. Recognition of the lesion and a thorough understanding of the organic changes in the vessel wall are sufficient contra-indications to an operation designed to attack the sympathetic innervation of an extremity. One cannot hope to dilate or constrict an arterial wall so altered by a pathological process such as Buerger has so carefully described in this disease.

DISCUSSION

In discussing the physiological effect of removal of the sympathetic innervation to an extremity, one is prone to go beyond the few known facts in order to furnish a plausible and logical explanation.

First of all, we know that arterial decortication or removal of the sympathetic chain produces hyperæmia and increased temperature in the corresponding extremity in man. Second, the symptoms of paralysis of the vasoconstrictors or unfettered influence of the vasodilators gradually disappear within from 1 to 2 weeks after the operation. Third, the sympathetic innervation to the blood vessels of an extremity is furnished at segmental intervals by way of the spinal nerves. Fourth, that any fibers of sympathetic origin within the blood vessel wall are not continuous along the wall of that vessel. Fifth, in certain vascular diseases of the extremities, characterized by paroxysmal vasomotor symptoms and the absence of organic vessel pathology, removal of the sympathetic chain is followed by an improvement in symptoms. Finally, we must bear in mind the fact that there are many variable factors concerned in the control of the peripheral circulation, of which the vessel musculature and caliber are but a part.

The known anatomical and physiological facts concerning the origin, distribution and supply of the sympathetic fibers to the extremities explain the results obtained upon interrupting such an innervation at its origin or in its course. Thus, removal of the sympathetic chain or severance of the somatic nerve supply produces definite physiological effects in the corresponding extremity. Such procedures and results are logical and in the event of interruption of the sympathetic chain are the result of removal of the active vasoconstrictor mechanism. Since the sympathetic innervation to the vessels of an extremity is supplied in a segmental manner, *a priori* the removal of a small portion of the terminations of these sympathetic fibers could not be expected to affect permanently any portion of the vessel except the local segment operated upon. On the other hand both local and distant favorable effects in the extremity after cortical decortication are reported. The effect of such a procedure upon the vessel caliber at the site of operation might very well be explained upon the basis of the interruption of a local short reflex mechanism within the wall of the vessel. Our knowledge makes it impossible to explain accurately the hyperæmia produced in the foot by removal of the adventitia upon a small segment of the femoral artery.

While it would seem more logical to remove

the sympathetic ganglia and rami rather than to decorticate an artery, we are still met with the inability to explain completely our results in cases of vascular disease of the extremities. Primarily we do not know the underlying pathology in these cases of vascular disease which would appear to be benefited by removal of the sympathetic innervation. It is assumed that those diseases in which no organic vessel pathology can be demonstrated are the result of a vasomotor neurosis and that the sympathetic innervation to the extremity is at fault. There are no facts to support such a contention except the empirical observation that removal of the sympathetic innervation effects an improvement. In view of the many circulatory factors previously pointed out which may have an important relation to these diseases, we cannot convince ourselves that an alteration in one of the peripheral mechanisms may be the sole key to the situation. This doubt is somewhat strengthened by the observation that the physiological results of interruption of the sympathetic innervation gradually become less pronounced and finally disappear. There is abundant experimental support for this clinical observation. Just what the actual mechanism of this readjustment is we are at present unable to say.

CONCLUSIONS

1. The peripheral blood vessels receive their sympathetic innervation in a segmental manner by way of the somatic nerves.

2. Removal of the sympathetic innervation to an extremity in man is followed by hyperæmia and hyperthermia which gradually disappear within one to two weeks following operation.

3. In certain vascular diseases of the extremities characterized by paroxysmal vasomotor symptoms and the absence of organic vessel pathology, removal of the sympathetic innervation is followed by an improvement in symptoms. Among this group we may include erythromelalgia and Raynaud's disease.

4. There are many physiological factors concerned in the control of the peripheral circulation, of which the vessel musculature and caliber are but a part.

5. In the present state of our knowledge concerning the pathology of the group of vascular diseases, known as vasomotor neuroses, we are unable to explain completely the effects produced by removal of the sympathetic innervation to the extremity.

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RECENT DEVELOPMENTS IN PERORAL ENDOSCOPY

Œsophagoscopy and Bronchoscopy for Disease; Report of Cases[1]

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BRONCHOSCOPY and œsophagoscopy, originally concerned chiefly in the removal of foreign bodies, have become most useful in the diagnosis and treatment of disease by bringing under direct inspection of the eye formerly invisible regions of the air and food passages. The following reports of cases illustrate different phases of the development of peroral endoscopy.

POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG

In recording the observations from the bronchoscopic examination of 2 cases of postoperative massive collapse of the lung, nothing new is offered as to etiology. The literature has been recently reviewed and the subject very ably considered by a number of observers, among them Dr. Walter Estell Lee (2) of The Pennsylvania Hospital of Philadelphia; Dr. Edward D. Churchill (1) of the Massachusetts General Hospital, Boston; and Dr. Simon Leopold (3) of the University of Pennsylvania Hospital, Philadelphia. Of the 2 cases here reported, the first occurred in a boy aged 13 years on the service of Dr. Walter Estell Lee at the Germantown Hospital, Philadelphia. This is believed to be the first case of postoperative massive collapse to be examined bronchoscopically. The examination was made January 14, 1925. That bronchoscopic study might possibly throw considerable light on the mechanism of postoperative pulmonary collapse had been suggested by Chevalier Jackson to Dr. Simon Leopold, who recorded this suggestion in his paper on the subject of postoperative massive collapse, but opportunity for bronchoscopic study had not presented itself until, at Dr. Lee's request, a bronchoscopy was done for this condition.

Case 1. A boy, 13 years of age, had been in good health until he developed acute appendicitis with abscess. He was admitted to Dr. Lee's service at the Germantown Hospital. The abscess was drained under ether anæsthesia, the procedure requiring only a few minutes. Thirty-six hours after the operation, he became acutely ill with symptoms of shock. Physical examination showed the signs of collapse of the right lung. X-ray examination confirmed these findings (Fig. 1, a). There was the typical displacement of the heart toward the affected side with evidence of increase of density of the affected right lung. The patient reacted from the acute symptoms, and 48 hours after the onset of the collapse bronchoscopy was done. There had been expectoration of the typical tenacious sputum, slightly greenish-grey in color, which when expectorated into a cup, stood up from the bottom of the cup like gumdrops. Bronchoscopy revealed the tracheal mucosa reddened and glary with greyish secretion adherent to the tracheal wall. The inflammatory condition became more marked in the lower trachea and right bronchus. The left bronchus was clear of secretion, the mucosa being only slightly inflammatory. The orifice of the right main bronchus was completely surrounded by a thick ring of tenacious secretion. The orifice of the right upper lobe bronchus was not completely blocked but patches of secretion were adherent to the wall of the bronchus. The stem bronchus and the middle and lower lobe bronchi were completely blocked with the thick secretion. The mucosa was very red and thickened. The secretion was aspirated from the larger bronchi.

It was noted that the right main bronchus deviated toward the right; there was no evidence of bronchial compression. There seemed to be marked restriction of the bronchial movements. Inspiratory opening and lengthening of the bronchus was very slight, particularly in the lower and middle lobe bronchi. Bronchoscopic diagnosis was diffuse bronchitis, involving the right main bronchus and its branches, most marked in the lower, stem, and middle lobe bronchi; bronchial obstruction of the middle and lower lobes with thick tenacious secretion. Swab specimen of secretion showed "pure culture of pneumococci."

Physical examination immediately following bronchoscopy showed evidence of air entering the right lung. The heart showed less displacement to the right (Fig. 1, b). Within 24 hours the collapse had recurred. At the end of 48 hours the right lung had begun to clear, the character of the sputum had changed, being mucopurulent, thin, and less tenacious. Bronchoscopy was repeated at the end of the third day and showed the inflammatory con-

[1]From the Chevalier Jackson Bronchoscopic Clinics. Presented at the Chicago Meeting of the American Academy of Ophthalmology and Oto-Laryngology, October, 1925.

Fig. 1, a.

Fig. 1, b.

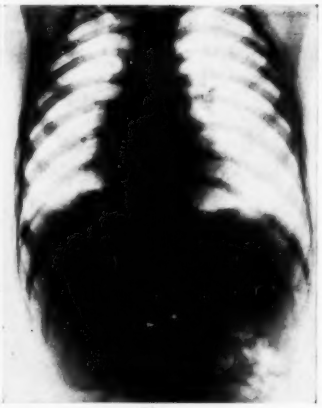

Fig. 2.

Fig. 1, a. Boy, aged 13 years, patient of Dr. Walter Estell Lee, developed massive atelectasis of the lower and middle lobes of the right lung 36 hours after drainage of an appendiceal abscess; ether anæsthesia. Roentgenogram 48 hours after onset of collapse before bronchoscopy. Note density of the affected side with displacement of heart and mediastinum toward the affected side. Compare with Figure 1, b.

Fig. 1, b. Roentgenogram 10 minutes after bronchoscopy. Air has entered the area of lung that showed collapse. The heart has moved back nearly to the normal position. The tenacious secretions were aspirated from all the larger bronchi.

Fig. 2. Roentgenogram (same case as that in Figure 1) 72 hours after the first bronchoscopy. Lung has cleared up almost entirely. Heart has gone back to normal position. Bronchoscopy at this time showed the character of the secretion had changed. There remained a purulent bronchitis but there was no blocking of the bronchus. The air passed in and out of the lower lobes without obstruction.

dition of the trachea and right bronchus to be less severe than at the previous examination. A small amount of secretion, slightly purulent in character, was aspirated from the right main bronchus; the left bronchus was free of secretion. The right bronchus showed no abnormal deviation, the bronchial movements seemed normal. The secretion in the middle and lower lobe bronchi was thin and was aspirated without difficulty. The bronchoscopic findings indicated that there was a much greater degree of secretion of the lower and middle lobes than at the first bronchoscopy. Previous to this bronchoscopic examination, the heart had gone back to practically the normal position and the physical signs indicated that there was good aeration of the right lung (Fig. 2). The recovery of the patient was uneventful following the second bronchoscopy. It was noted by Dr. Lee (2) that the collapsed lung cleared within 72 hours after the first bronchoscopy, while in the other cases of his series in which bronchoscopic treatment had not been carried out, the recovery had extended over an average period of 21 days.

Case 2. The second case occurred on the service of The Chevalier Jackson Clinic at the Jefferson Hospital. A boy, 6 years of age, had been operated on for the closure of a gastrostomic fistula that had been made for the purpose of retrograde treatment of cicatricial stricture of the œsophagus. The stricture of the œsophagus was cured and the gastrostomy opening had been closed. Ether anæsthesia was used during the operation. The patient coughed a great deal and was troubled with considerable secretion during the anæsthesia. Thirty-six hours after the operation pulmonary symptoms developed, and by the end of 48 hours, the typical signs of postoperative massive collapse of the left lung were present. Seventy-two hours after the operation bronchoscopy was done, July 13, 1926. Very thick, tenacious secretion, whitish-yellow in color, was found in the trachea and left bronchus. The mucosa of the bronchus was very inflammatory. Following aspiration, air seemed to enter the left lung. Ten cubic centimeters of the thick, whitish-yellow exudate were aspirated, and a culture of the removed secretion showed pneumococci and staphylococci. Dr. Manges' report on the roentgenogram (Fig. 3), June 13, 1925, reads: "There is complete collapse of the left lung; trachea and heart are drawn well to the left. It is impossible to see the shadow or outline of the heart or left diaphragm. The lung shadow is equal in density to that of the heart so that there is no detail at all seen in the left chest." Films made 1½ hours after bronchoscopy show: "The lungs contain a considerable quantity of air. The trachea is near the median line, the right border of the heart is even with the right border of the spine shadow and the outline of the diaphragm as well as the left border of the heart is clearly seen. There is evidence of function because there is more air in the left lung at inspiration than there is at expiration (Fig. 4, a,b). This indicates definitely that some obstruction was removed from the left lung at the time of bron-

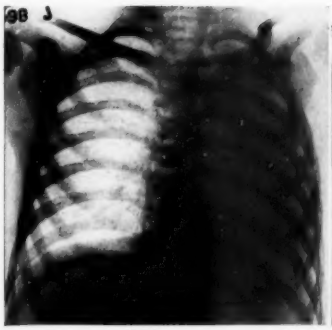

Fig. 3.

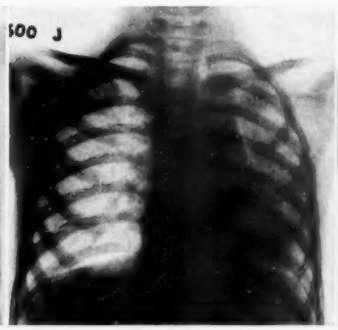

Fig. 4, a

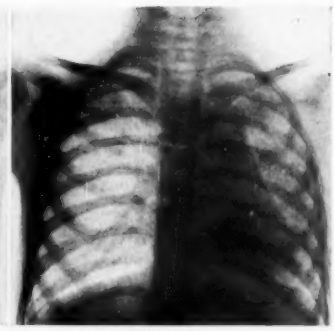

Fig. 4, b.

Fig. 3. Postoperative massive collapse of the entire left lung coming on 72 hours after abdominal operation under ether anæsthesia.

Fig. 4, a. Roentgenogram, on expiration, 1 hour after bronchoscopic aspiration shows decided clearing of the left lung. Compare with Figure 4, b.

Fig. 4, b. Roentgenogram taken at inspiration. Comparison of the roentgenograms a and b shows more air in the left lung during inspiration indicating that there has been return of function following the bronchoscopic aspiration. The roentgenograms in this case were made by Dr. Manges.

choscopy." The lung showed evidence of collapse again in 42 hours after the first bronchoscopy, the X-ray examination gave the same findings as before bronchoscopy. Bronchoscopy was again performed and 14 cubic centimeters of thick, yellowish secretion were aspirated (Fig. 5). X-ray examination again showed return of function in the lung. Three days later, the collapse had recurred and another bronchoscopy was performed. The secretion was less in amount and less tenacious in character. The aeration of the left lung remained improved for a considerably longer period, but there was still evidence of considerable secretion in the chest and one week later bronchoscopy was again performed and 4 cubic centimeters of the thick, tenacious material were aspirated from the left lung, principally from the lower lobe bronchus. Two subsequent bronchoscopies were done after intervals of 2 and 5 days respectively, and following this the patient was able to keep the lung free of secretion. The cough reflex seemed to have returned and his improvement was progressive and he was discharged from the hospital well, 6 weeks following the onset of the postoperative massive collapse. In all, 6 bronchoscopies were done during a period of 20 days.

In the second case, the secretion was more purulent in character than in Case 1, which can probably be accounted for by the presence of the staphylococci. The patient also seemed more toxic and was very much less able to cough up the thick secretion.

We have demonstrated bronchoscopically that bronchial obstruction exists. The tenacious mucus, which Pasteur and practically all other observers state is coughed up in all cases, acts as a foreign body. Whether this tenacious secretion is produced by the collapse of the lung squeezing the secretion into the bronchi, or whether its presence there causes collapse of the lung due to the absorption of the air in the portion of the lung obstructed, does not influence the fact that it is necessary to remove the obstruction by aspiration, by absorption, or by liquefaction and coughing it up. In some manner it must be removed so that air can enter before the lung can possibly expand.

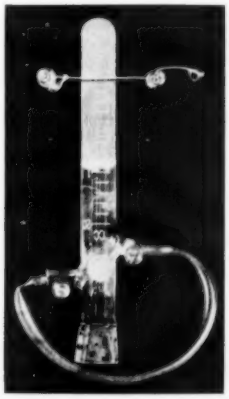

Fig. 5. Photograph of inverted test tube containing the secretion aspirated from the lung in postoperative massive collapse. The thick, gelatinous secretion remains at the bottom of the inverted tube.

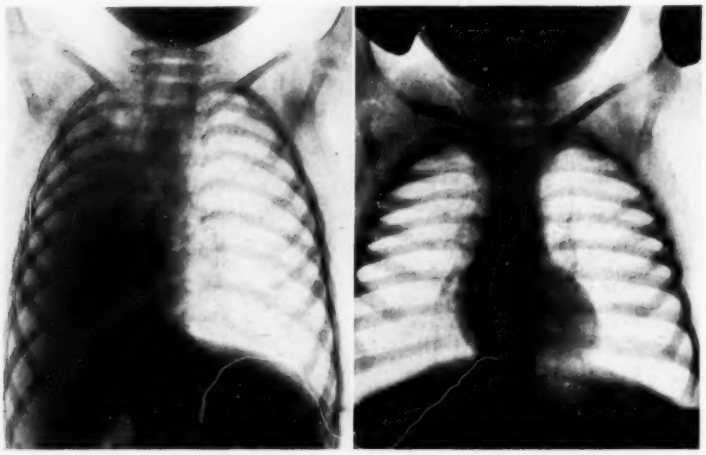

Fig. 6, a, (left). Massive atelectasis of the entire right lung 48 hours after the lodgment of a bean in the right main bronchus. Compare with Figures 1, a and 3, roentgenograms of postoperative massive collapse.

Fig. 6, b. Roentgenogram 24 hours after the bronchoscopic removal of the bean showing the lung has expanded to normal and the heart gone back to normal position. Roentgenogram by Dr. Pancoast.

Dr. Manges has proved by roentgen-ray examination that function is restored following bronchoscopic removal of the obstructing secretion, and we have been able to demonstrate by repeated bronchoscopies in the second case that the tenacious secretion blocks the bronchus when collapse is present. Bronchoscopy, after the collapse has disappeared, shows purulent secretion present but not obstructive in character or quantity.

We have seen massive obstructive atelectasis in many cases when the bronchus was blocked by foreign body. The foreign body that is the most effective in producing atelectasis is the dried bean (Fig. 6, a and b). This object, because of its shape, when lodged in the bronchus blocks the passage of air; and the action of warmth and moisture in the bronchus produces a rapid increase in the size of the bean, corking the bronchus completely. Atelectasis is very quickly and effectively produced. The physical signs and X-ray findings are the same as those in postoperative massive collapse. The removal of the bean uncorks the lung and it rapidly expands, and in a few hours returns to normal. The obstruction is completely removed. In the cases of massive collapse when the secretion has been removed bronchoscopically, partial function is restored immediately, but it is not possible to aspirate all of the secretion from the finer bronchioles. The secretion re-accumulates in the larger bronchi and the collapse recurs due to the complete plugging of the bronchi. The indication is clear for early bronchoscopic aspiration of secretion. The procedure is carried out with local anæsthesia in adults and no anæsthesia in children. The question as to what patient should be subjected to aspiration is one for the surgeon who has knowledge of the operative condition to decide.

When re-accumulation occurs, repeated aspiration should be carried out until the weakened respiratory force revives, the cough reflex returns, and the lung is able to rid itself of the obstruction; or in other words, until the viscious circle of obstruction atelectasis, atelectasis obstruction is eliminated.

POST-TONSILLECTOMY AND POSTOPERATIVE PULMONARY ABSCESS

Post-tonsillectomy and postoperative pulmonary abscess are now recognized as being of much more frequent occurrence than was formerly believed. The supposed "catching

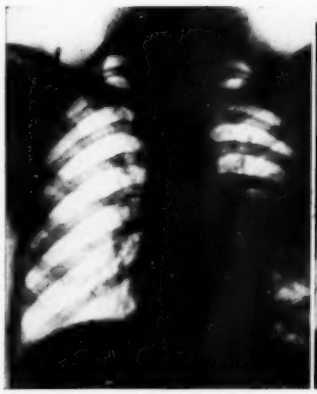

Fig. 7.

Fig. 7. Post-tonsillectomy abscess. Roentgenogram of a man 40 years of age showing a pulmonary abscess in the left lower lobe, with pleural involvement. Bronchial symptoms came on 4 days after tonsillectomy. Film was made 5 months later on his admission to the clinic. This was thought to be a case for external drainage but the pleural involvement cleared rapidly, and in consultation with the surgeon it was decided that bronchoscopic treatment be carried out. This was done at weekly intervals. See Figure 8.

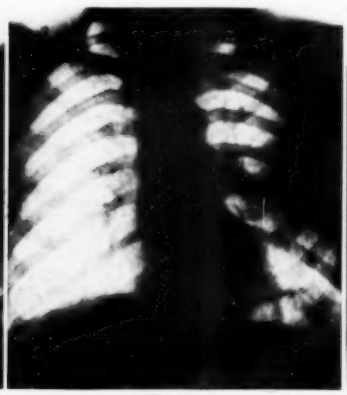

Fig. 8, a.

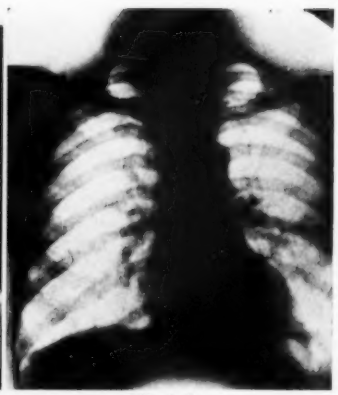

Fig. 8, b.

Fig. 8, a and b. Post-tonsillectomy abscess. These roentgenograms show a progressive decrease in the area of the lung involved. The man gained 25 pounds in weight while under bronchoscopic treatment. Roentgenograms made at the end of 3 months show the lung almost clear. Report at the end of 6 months from the referring physician, Dr. Robert D. Spencer, states that the patient is well and roentgen-ray examination is negative for evidence of the former lung abscess.

cold" following tonsillectomy or other operative procedures is now recognized as a direct complication following the operation. As to the mode of infection, some cases are undoubtedly due to aspiration of infective material at the time of operation. This is proven by the aspiration of deciduous teeth which have been dislodged at the time of the tonsil operation and inspired into the lung with resultant abscess. Recently the author removed bronchoscopically from the left bronchus of a patient a tonsil sponge that had been aspirated during the course of a local tonsillectomy.

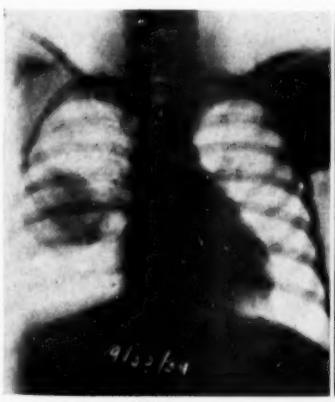

Fig. 9, a.

Fig. 9, b.

Fig. 9, c.

Fig. 9, a. Post-tonsillectomy abscess. Roentgenogram of a child 7½ years of age. Pulmonary symptoms developed 1 week following tonsillectomy. Films made 7 weeks after tonsillectomy, showing abscess of the right middle lobe.

Fig. 9, b and c. Films made 2 days later showing marked extension of the pathological process. Bronchoscopy was done, aspiration carried out. Following this the child evacuated large quantities of pus, Figure 9, c.

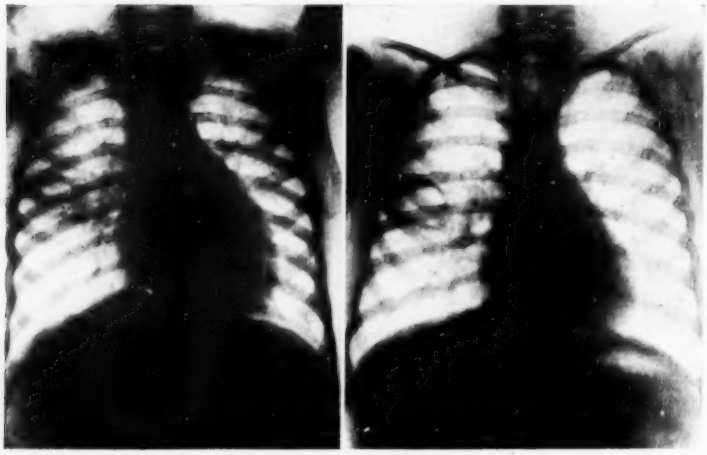

Fig. 10, a and b. Post-tonsillectomy abscess. Films taken at intervals of 1 week showing progressive clearing following the two bronchoscopic treatments. Child completely recovered.

If foreign material of this type can be aspirated, it is reasonable to conclude that infective material can be aspirated in the same manner that would result in abscess formation. The infection may also occur through the blood stream, as has been proven by the work of Fetterolf and Fox and other observers. It would seem that bronchoscopic aspiration would be most effective in the cases in which the abscess is due to inspiration of infective material. We have not, however, been able to prove this in the bronchoscopic treatment of post-tonsillectomy pulmonary abscess. The results of bronchoscopic treatment in many cases have been very encouraging; in a few cases bronchoscopic aspiration has resulted in prompt cure. Our experience has led us to believe that the sooner the bronchoscopy is done, particularly in cases due to aspirated infection, the more promptly the beneficial results are obtained. Three cases are reported here in which bronchoscopic treatment undoubtedly contributed very greatly to the cure.

CASE 1. A male, aged 40, had a tonsillectomy 5 months before admission to the Clinic. Pulmonary symptoms commenced 4 days following tonsillectomy. At the end of the first week there were elevation of temperature and cough with expectoration of foul sputum; and it was thought that he had "caught cold" following tonsillectomy. He did not improve under medical treatment and at the end of 4 months he consulted Dr. Robert D. Spencer of Ashland, Pennsylvania, who, after X-ray studies and bronchoscopic examination, diagnosed the condition "pulmonary abscess involving the lower lobe of the left lung." When the patient came to the Clinic it was found that there was a pyramidal area in the left lower lobe that extended outward from the hilus of the lung toward the pleura with the base outward (Fig 7) and physical examination showed there was pleural involvement. The surgical consultant advised observation of the patient, and if the condition should not improve, he felt that external drainage would be the proper procedure. At the end of a week the pleural signs had cleared to some extent. X-ray examination showed there was a decided decrease in the involved area in the left lower lobe, particularly had there been a clearing up of the peripheral area of the lower lobe. The patient was kept under observation and improvement continued. At the end of 4 weeks, he developed a fever, 101 degrees F., and complained of sore throat. Examination at that time showed that he had an acute infection of the upper respiratory tract. Following this the amount of expectoration increased, but the area of involvement in the lung, while larger, seemed to have cleared up at the periphery, at the point of pleural involvement. In consultation it was decided that bronchoscopic drainage should be done. This was carried out at semi-weekly intervals and after 8 bronchoscopies there was no sputum being expectorated, the man had gained 25 pounds in weight, and repeated roentgen-ray examinations showed a progressive decrease in the area of lung involved (Fig. 8, a and b). At the end of 2 months following the beginning of bronchoscopic treatment, the lung had cleared up

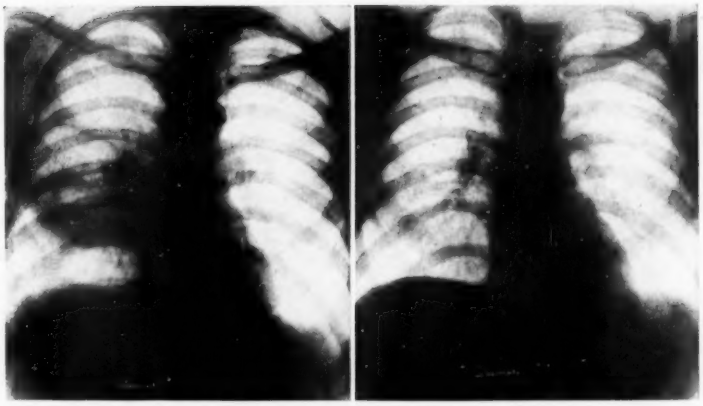

Fig. 11, a, (left). Postoperative pulmonary abscess. Patient, 30 years of age. Roentgenogram made 5 weeks after the onset of symptoms showing marked evidence of a pathological process in the right lower and middle lobes. Bronchoscopic treatment was begun at this time. Seven bronchoscopies were done at intervals of 1 week.
Fig. 11, b. Roentgenogram made 6 months after bronchoscopic cure. Patient had gained 40 pounds in weight and was symptomatically well. Films by Dr. Pancoast.

completely. There is now no expectoration, and the patient has been discharged well. In this patient there was a contra-indication to bronchoscopy when he was admitted, because of the pleural involvement; and it was felt advisable to consider external drainage. On the improvement of the pleural complication the contra-indication was removed, and when the patient ceased to improve, bronchoscopic treatment was instituted and rapid cure resulted.

CASE 2. A boy 7½ years of age was referred to the Clinic 7 weeks following tonsillectomy. The operation had been performed under ether anæsthesia. In the first week following the operation the child developed a cough and had pulmonary symptoms up to the time of admission. He had lost weight and there had been an afternoon rise of temperature to 101.4 degrees F. A roentgen-ray examination by Dr. W. F. Manges, 3 days prior to admission, showed an abscess in the lower portion of the right upper lobe. X-ray examination the day following admission showed an increase in the area of involvement. Physical examination also indicated that there was an extension of the pathological process. Diagnostic bronchoscopy was done and evidence of a suppurative process was found in the right upper lobe. A swab culture taken showed a practically pure culture of pneumococci. There had been no expectoration prior to bronchoscopy, but following bronchoscopy there was considerable cough and expectoration of very foul pus. The child's general condition showed improvement immediately. Two days later a second bronchoscopy was done and considerable quantity of very foul pus was aspirated from the right main and upper lobe bronchus. The pus was found to be coming entirely from the right upper lobe bronchus. Roentgen-ray examination following bronchoscopy showed marked improvement (Fig. 9, a, b, c). The abscess had been evacuated. The area of involvement in the right upper lobe showed a cavity 1 inch in diameter that was free of fluid. The patient's temperature came down to normal and remained there. Roentgen-ray examination 4 days later was reported by Dr. Manges as showing a distinct diminution in the area involved. The improvement was progressive. At the end of a week another X-ray examination was made and Dr. Manges reported definite improvement and a clearing up of the inflammatory area (Fig. 10, a and b). The patient was discharged from the hospital and his improvement continued to complete recovery.

CASE 3. A male, aged 30 years, a former enlisted man in the British Navy, was injured by the blowing off of the top of a pneumatic paint spraying machine that he was using, the top striking him on the neck, jaw, and right chest. He had a fracture of the lower jaw in two places and a number of teeth were dislodged. He was operated upon 5 weeks after the injury, under local anæsthesia. A portion of the lower jaw was removed and several teeth were extracted. Four weeks later a second operation was done, and additional teeth were removed with a second piece of the lower jaw, the procedure being done under gas and ether anæsthesia. Two days later he developed a severe pain in his chest, and 5 days following the operation he began to expectorate blood-stained pus. The productive cough and septic temperature range continued during the next 3 weeks. X-ray examination prior to admission showed a pulmonary abscess in the right lower and middle lobe. (Fig. 5, a). He was referred to the Clinic by Dr. John S. Eynon, of Chester, Pennsylvania,

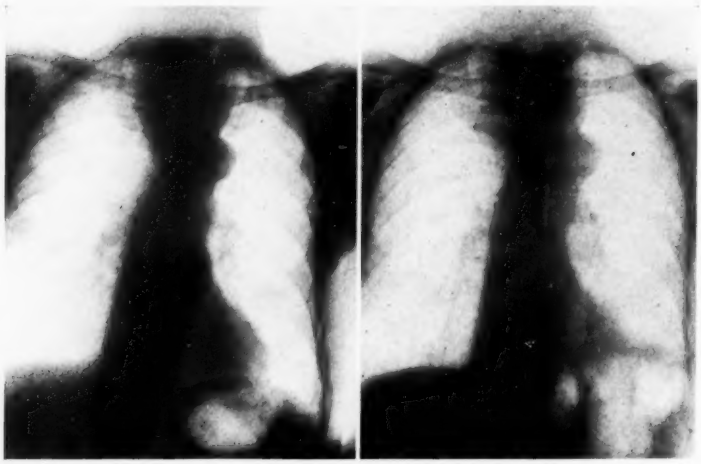

Fig. 12, a, (left). Bronchoscopic aid to tracheotomy. Cancer of the thyroid gland involving the trachea. Bronchoscope was introduced below the cancerous involvement of the trachea, the neck opened in the front, a No. 5 tracheotomic cannula inserted as the bronchoscope was withdrawn.

Fig. 12, b. Showing the tracheotomy tube in position.

for bronchoscopic treatment. Roentgen-ray examination revealed no evidence of foreign body. Bronchoscopic examination showed very foul, blood-stained pus in the bronchus and trachea. After aspiration it was found to reappear from both the lower and middle lobes. The mucosa of the right lower and middle lobe bronchi was very inflammatory. Pus was aspirated and local medication applied; no foreign body was seen on bronchoscopic examination. The surgical consultant advised that bronchoscopic aspiration be carried out. The patient's blood Wassermann was negative. The culture from the swab specimen taken at the first bronchoscopy showed streptococcus mitis (non-hæmolytic) to be the predominating organism. Vaccine was made from this culture and administered by the medical consultant. Bronchoscopy was repeated at weekly intervals, pus aspirated, and local medication applied. The patient's condition improved progressively and after 5 bronchoscopies the inflammatory condition of the middle and lower lobe bronchi had almost entirely disappeared. The pus had lost its odor and had become thin in consistency and whitish in color. The man's general condition had improved markedly and he insisted on getting up around the ward, his temperature having been normal for a period of 2 weeks. He was allowed to go home and return as an out-patient for treatment. X-ray examination at this time showed marked diminution of area of involvement in the right lung. Bronchoscopies were carried out at weekly intervals and at the seventh, the third after he left the Hospital, the bronchus was found practically normal and the tracheobronchial tree free of pus. The man had gained 25 pounds in weight, and X-ray examination at this time showed progressive improvement. Bronchoscopy was discontinued 2 months later, and the patient returned at the end of another 2 months for observation. He was found to be in excellent physical condition. His weight on admission had been 105 pounds, and at the time of his return it had increased to 152 pounds. X-ray examination showed the right chest practically normal(Fig. 11, b).

The patient presented an unusual complication because of the fracture of the lower jaw. It was found possible to expose the larynx by working from the left side of the man's mouth instead of the right, as is the usual route, without discomfort or interference with the injured lower jaw; and in this manner the treatments were carried out.

This demonstrates that bronchoscopy can be done, as Jackson states, in any patient whose mouth can be opened widely enough to admit a bronchoscope.

BRONCHOSCOPIC AID TO TRACHEOTOMY

There are certain pathological conditions, in which there is tracheal compression and displacement of the trachea, in which bronchoscopic aid in maintaining the airway and finding the trachea for insertion of the tracheotomic cannula is invaluable.

CASE 1. A man, aged 65, was seen in consultation with Dr. Frank Bridgett. He was very dyspnœic

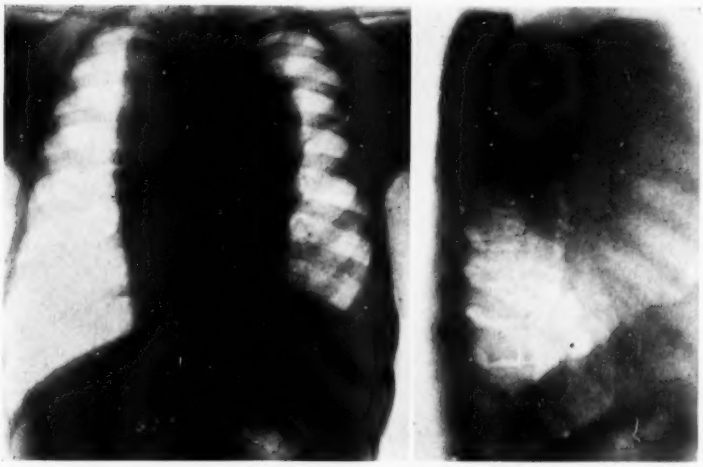

Fig. 13. Bronchoscopic aid to tracheotomy. Roentgenogram showing large mediastinal tumor compressing the trachea and left bronchus, and leaving a narrow lumen into the right bronchus. Bronchoscope was inserted down to the right bronchus, trachea incised with the bronchoscope in position, tracheotomy tube introduced into the right bronchus on withdrawal of the bronchoscope.

and had a massive enlargement of the thyroid gland, malignant in character, which covered the larynx and extended downward to the upper thoracic aperture, bulging outward above the suprasternal notch (Fig. 12). Mirror examination showed a bilateral recurrent paralysis, although the dyspnœa was both inspiratory and expiratory. The question of tracheotomy had been considered and it was thought impracticable because of the enormous size of the thyroid and the resultant tracheal compression and displacement. It was felt that the only possible way to perform a tracheotomy was to insert a bronchoscope and maintain the airway while the trachea was being found. On insertion of the bronchoscope through the paralyzed larynx it was found that a fungating, ulcerating mass projected into the tracheal lumen at the level of the suprasternal notch. We were able to insert a 6 millimeter bronchoscope through the narrowed tracheal lumen. The incision was then made through the enlarged thyroid and it was found that the trachea was displaced beneath the border of the left sternomastoid muscle.

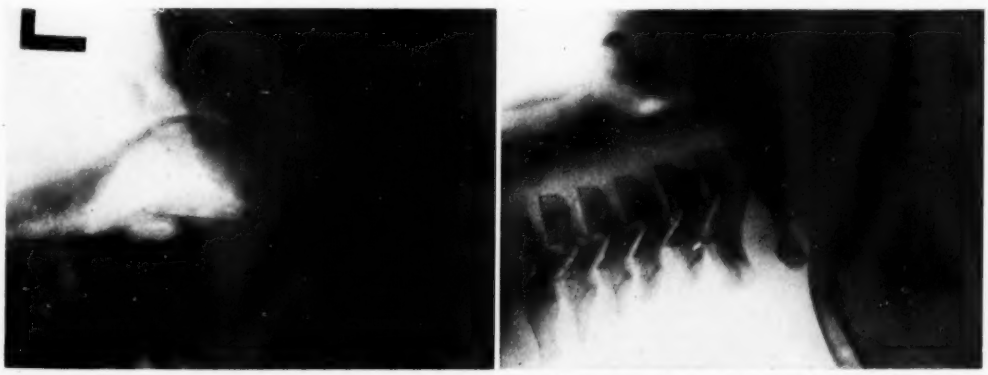

Fig. 14, (left.) Bronchoscopic aid to the evacuation of a retropharyngo-œsophageal abscess. Roentgenogram of a boy, 9 years of age, showing an enormous retropharyngo-œsophageal abscess following a puncture wound through the trachea and œsophagus by a sharp portion of glass. Bronchoscope was inserted through the larynx in order to prevent aspiration of pus. Abscess was evacuated from the hypopharynx.

Fig. 15. Showing the same region in the neck after complete cure of the abscess.

The carcinomatous thyroid had so involved the trachea that its walls could not be distinguished. In order to find the trachea the bronchoscope was withdrawn partially, the lights in the room lowered and the trachea found by transillumination. An incision was made in the trachea and a cane-shaped Jackson's tracheotomic cannula inserted, passing below the level of the malignant involvement of the trachea.

CASE 2. A young man, 19 years of age, was referred from the medical service of Dr. Stengel of the University Hospital with marked dyspnœa. The diagnosis was of lymphosarcoma of the mediastinum. The case was not considered as amenable to surgery and before X-ray treatment was carried out. it was advised that tracheotomy should be done. A lateral X-ray examination by Dr. Pancoast showed a large mediastinal tumor producing marked obstruction of the trachea. The mass extended upward from the anterior mediastinum into the neck to the level of the cricoid cartilage (Fig. 13). Preliminary to tracheotomy a bronchoscope was inserted and it was found that there was compression of the trachea almost obliterating its lumen from the level of the suprasternal notch down to the bifurcation. The left bronchus was also compressed. The bronchoscope was allowed to remain in position while the tissues overlying the trachea were separated, the tracheal rings were incised, the bronchoscope withdrawn to the level of the opening in the trachea and a long, Jackson, cane-shaped tracheotomy tube inserted, reaching down to the level of the bifurcation. In this way air was carried down to the right lung which was still functioning.

BRONCHOSCOPIC AID TO ŒSOPHAGOSCOPIC EVACUATION OF A RETROPHARYNGO-ŒSOPHAGEAL ABSCESS

A boy, aged 9 years, was admitted to the surgical service of Dr. E. L. Eliason at the University Hospital. One hour before admission he had sustained a stab wound in the front of the neck caused by falling on a sharp portion of a glass bottle The sharp pointed portion of glass had passed through the trachea and œsophagus. His general condition was good, but there was present marked subcutaneous emphysema which involved the neck and face up to the level of the zygoma and extended downward over the upper portion of the chest. There was a transverse incision in the front of the neck just below the cricoid level through which air passed on forced breathing. There was no dyspnœa and no bleeding. Lateral X-ray examination of the neck showed no evidence of glass. Bronchoscopic examination showed a transverse wound in the anterior tracheal wall just below the level of the cricoid and a puncture wound of the party wall into the œsophagus at the same level. No foreign body was found. The wound was dressed by packing the skin open so that healing would take place from the trachea outward. The child's condition remained good until the third day when its temperature rose to 104 degrees. F. There developed considerable difficulty in swallowing. The temperature still remained high, the difficulty in swallowing increased, and there was marked dyspnœa. On the fourth day it was thought that the patient was developing a retropharyngeal abscess. On the fifth day following the accident, a roentgenogram by Dr. Pancoast showed an enormous retropharyngo-œsophageal abscess which was obstructing the larynx from above and compressing the trachea below the level of the cricoid (Fig. 14). On consultation it was decided to evacuate the abscess œsophagoscopically. It was deemed advisable to insert a bronchoscope prior to evacuation of the abscess because of the tracheal compression and the danger of aspiration of pus into the lung. On insertion of the bronchoscope pus was found to be coming from the puncture wound on the posterior tracheal wall. The trachea was compressed so that its lumen was slit-like down to the level of the suprasternal notch. Dyspnœa was entirely relieved by the insertion of the bronchoscope. The abscess was then evacuated through the pharynx by means of the direct laryngoscope used as an œsophageal speculum. The post-pharyngeal wall was incised just above the cricopharyngeal fold and an enormous amount of very foul pus and gas was evacuated, the infection being due to some gas-producing organism, probably colon bacillus. Pus was aspirated from the abscess cavity and the pharynx until the field was clean. The bronchoscope was removed, pus being aspirated from the trachea, the dyspnœa was relieved and the child returned to bed in good condition. The following day there was slight re-accumulation of pus which was aspirated through the incision in the post-pharyngeal wall, the direct laryngoscope being used for exposing the opening in the hypopharynx, the patient's head being held low over the edge of the table so as to prevent aspiration of pus into the lung. It was necessary to aspirate the pus in this manner as it re-accumulated on 3 successive days, after which time the abscess drained itself without further aspiration and the boy's condition progressed to complete recovery. X-ray examination of the neck at the end of one week showed that no evidence of mediastinal infection or retropharyngeal abscess persisted (Fig. 15). Recent bronchoscopic examination showed that only slight stenosis resulted from the tracheal injury. The child's condition was otherwise normal.

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DIABETIC AND ARTERIOSCLEROTIC GANGRENE OF THE LOWER EXTREMITIES

Analysis of One Hundred Cases of Amputation

By ELDRIDGE L. ELIASON, M.D., F.A.C.S., and V. W. MURRAY WRIGHT, M.D., Philadelphia

IN this discussion of diabetic and arteriosclerotic gangrene of the lower extremities we have included 100 cases. Though more cases were available, only those were chosen that were complete and from which reliable data could be obtained. The analysis has been made with the view of presenting various facts regarding so-called diabetic gangrene, with the hope that by a better knowledge of gangrene in diabetics and arteriosclerotics, a keener interest and regard will be awakened in the profession that will bring about a greater saving of the extremities and lives of those unfortunate victims of the trepidation and procrastination on the part of both themselves and their advisers.

In the preface to his new edition, Joslin aptly remarks: "Surgery is entirely re-written because diabetes is so often a surgical problem, more than one-fifth of all Boston diabetics dying of gangrene."

PATHOLOGY

The more cases of gangrene in diabetes that one sees the more one is impressed with the fact that it is analagous to senile or arteriosclerotic gangrene with the added local and general disturbances of metabolism that occur in diabetes.

Arteriosclerotic gangrene (21) is the result of obliterating endarteritis and occurs in the very old, in whom the heart is generally feeble and the kidneys diseased, thus contributing to the impairment of nutrition. The arteries become calcareous and inelastic, and much reduced in caliber. The actual onset of gangrene is often determined by a slight injury or inflammation, which induces thrombosis in smaller vessels or a thrombus may form in the main artery supplying the limb.

It is not held that arteriosclerosis is the cause of diabetes but that it is a contributing cause in the occurrence of diabetic gangrene, for as Joslin (10) points out, "arteriosclerosis is of common occurrence in protracted cases of diabetes. It seldom occurs even in the severest cases of diabetes in youth and not frequently before the age of 50 years—a strong argument against diabetes being a direct causative factor of arteriosclerosis. The comparative rarity of diabetic gangrene under the age of 60 years is also evidence in the same direction."

That the local manifestation of gangrene in diabetic extremities is due to a disturbed local circulation is shown by the careful studies of Buerger (1) who states that a study of the condition of the arteries and veins in limbs amputated for so-called diabetic gangrene reveals the fact that in each and every instance we are dealing not with a gangrenous process due to the diabetes per se but with a mortifying process dependent upon extensive arterial disease. In short, characteristic of so-called diabetic gangrene is the presence of the typical lesions of arteriosclerosis that differ in no way from the lesions of the arteries of the arteriosclerotic or senile gangrene, and that justify the conclusion that in diabetic gangrene we are dealing with an arteriosclerotic process.

Joslin (10) adds that if one needs to be convinced of the uselessness of attempting to save most gangrenous legs, the specimens removed at operation should be studied. These show how hopeless it is to expect the arteries to regain their function. Regret is felt, not for the removal of the leg at the time, but rather that it had not been removed earlier. Extensive thrombosis of a leg precludes healing.

Under the caption "Arteriosclerotic Gangrene with Diabetes," Buerger (2) writes that such gangrene usually eventuates after traumatism, thermal or mechanical. The narrowing and rigidity of the arteries, coupled with the presence of the metabolic deficiencies due to the diabetes are sufficient to lead to gangrene of the tissues upon the mere action

of a trifling trauma. He likewise gives a very good and concise pathological description of his examination.

In our own series it is interesting to note that of the 15 cases in which the pathological or X-ray reports were recorded, every one, or 100 per cent, showed arteriosclerosis!

AGE

Diabetes is a disease of adult life (15), the majority of cases occurring between the third and sixth decades. Of 276 cases (Osler, 15) 70 of them, 25 per cent, occurred between 50 and 60 years of age. While it is true that diabetes occurs in the very young, though rarely with gangrene, and at an age too early for arteriosclerosis, the gangrene nevertheless is probably primarily due to a circulatory disturbance in the form of a thrombotic process of thermal or mechanical origin.

Gangrene was found by Morrison (13) to be a contributory cause of death in 23 per cent of 775 fatal cases of diabetes between the years 1895 and 1913. In 84 cases, 3 per cent, of his series (Table I), Joslin finds a lower relation.

The table below of the ages in which gangrene occurred in 2,611 of Joslin's cases is interesting in that he calls attention to the fact that one in every five of his patients who developed diabetes above the age of 70, also developed gangrene, whereas the frequency was but half as great in the preceding decade. The average age at which gangrene developed was 61 years.

TABLE I.—GANGRENE IN RELATION TO AGE AT ONSET OF DIABETES (JOSLIN)

Age at onset of diabetes	Total cases of diabetes	Cases gangrene	Per cent
Under 30 years	683	4	0.6
31 to 50 years	1080	26	2.2
51 to 60 years	581	23	3.6
61 to 70 years	226	23	10.0
71 to 80 years	41	8	19.5

Joslin looks upon the sixth and seventh decades in life, particularly the latter, as the dangerous period in diabetics for gangrene and finds the advancing years of duration of diabetes, as well as the advancing years of life, likewise effective in the production of gangrene.

In our series we find a lower age relation than he does, and also a lower age among females than in males, and in diabetics compared with arteriosclerotics. While the average age was 61 years for the development of gangrene in Joslin's series, we find the average to be 59.2 years for both sexes, 57.04 years for females and 60.6 years in males, or an average of 3.56 years earlier in females than in males. The youngest among our diabetics was a female of 34 and the eldest a male of 79 years of age.

A glance at Table II will show that among our cases 29, 52.7 per cent, occurred in the decade preceding the sixth decade as compared to 16 cases, 29 per cent, between the age of 60 and 70 years.

A comparison of the age groups of gangrene in diabetics and in arteriosclerotics reveals the interesting fact that gangrene (in the authors' series) occurs in diabetics a decade before it makes its appearance in sclerotics. This fact leads one to wonder if with its local and general disturbances of metabolism, diabetes causes gangrene in the early stage of arteriosclerosis whereas true arteriosclerotic gangrene occurs in the terminal stages of local circulatory impairment. If such is the case, then early arteriosclerosis is as serious in diabetics as late sclerosis is in the aged. The average age in which gangrene (arteriosclerotic) occurred in males was 64 years, in females 68.66 years, in both sexes 64.93 years. And whereas, gangrene occurred 3.56 years sooner in diabetic females than in males, gangrene in the aged occurred 4.66 years sooner in males than in females.

TABLE II.—AGE OCCURRENCE IN ONE HUNDRED CASES OF GANGRENE

Arterio-sclerosis													
Sex	30	35	40	45	50	55	60	65	70	75	80	Aver-age	Total
Males	0	2	2	0	0	5	8	7	5	4	3	64.0	36
Females	0	0	0	0	0	2	1	2	2	1	1	68.66	9
Diabetes													
Males	0	0	0	1	6	11	4	7	2	2	0	60.6	33
Females	1	0	0	2	7	5	3	2	2	0	0	57.04	22
Total	1	0	0	3	13	16	7	9	4	2	0	59.2	55

In the arteriosclerosis group of gangrene the earliest age of incidence was 37 years and the eldest 84 years as compared with 34 years and 79 years in diabetics.

TABLE III.—RATIO OF SEX AND DEATH IN GANGRENE

Form of gangrene	Sex	Average occur.	Average death	Total cases	Per cent sex	45	50	55	60	65	70	75	80	Total death	Mortality	Per cent sex die
Arteriosclerosis.....	M	64.0	72.77	36	80	0	0	0	1	2	2	1	3	9	20	25
	F	68.66	71.5	9	20	0	0	1	1	1	2	1	0	6	13.3	66.6
	Total	64.93	72.76	45	100	0	0	1	2	3	4	2	3	15	33.3	33.3
Diabetes.....	M	60.6	59.9	33	60	0	3	3	1	2	2	0	0	11	20.0	33.3
	F	57.4	50.94	22	40	1	4	2	3	2	1	0	0	13	23.6	59.1
	Total	59.2	59.4	55	100	1	7	5	4	4	3	0	0	24	43.6	43.6

SEX

Arteriosclerosis per se is more common among men than women. Diabetes per se remains yet to be determined regarding its sex incidence. Statistics tend to show that diabetes occurs more often in men than in women. As more men than women carry life insurance and urinalyses are performed more often in men and with less hesitancy, more cases have been found among males than in females. It is probably true though that the disease is most common among males.

Osler (15) states that the ratio is as 3 for men to 2 for women. Futcher (10) in 276 cases found the relation to be 64.85 per cent for males compared with 35.15 per cent for females. Stevens (19) remarks that men are somewhat more frequently affected than women, although apparently more of the latter succumb to the disease. This is in accordance with statistics. In Joslin's series of 355 cases occurring among Jews, he noted 171 males and 184 females. It is interesting to note the part the insurance companies are playing in discovering diabetes among otherwise apparently healthy individuals. Joslin states that between 1893 and 1916, 6 out of 1,000 of his cases were discovered by insurance companies' routine examinations, that it increased to 9 cases during the next four succeeding years, and to 13 during the period 1920 to 1923. He further states that sex affects normal metabolism in that females have a lower metabolism than males of the same age, height, and weight, and in diabetes the same relation holds.

Of 84 cases (Joslin) of gangrene occurring in diabetics more than twice as many males (58 cases) were affected as females (26 cases).

In our own series we find that of 55 cases of gangrene in diabetics the proportion was as 33 males, 60 per cent, to 22, 40 per cent, females. This is surprising in comparison to the relation of sex in our cases of arteriosclerotic gangrene in which the relation in 45 cases was as 36, 80 per cent, in males to 9, 20 per cent, in females. The comparison of gangrene in diabetes and in arteriosclerosis in Table III shows that diabetic gangrene occurs earlier than in arteriosclerosis and that the patients die earlier in the disease and at a younger age.

Our statistical analysis shows that the average duration of life in arteriosclerotic gangrene is longer (7.23 years) than in the diabetic form (0.2 years or 72 days) and that the average age of occurrence (64.93:59.2 years) is 5.73 years earlier in the latter form and that they likewise (72.26:59.4 years) die at an earlier age; in fact, 12.86 years sooner.

Diabetic gangrene shortens life a full decade more than arteriosclerotic gangrene.

TABLE IV.—TRAUMA AS A FACTOR IN GANGRENE

Disease	Sex	Trauma	No trauma	Total cases	Per cent
Arteriosclerosis	Male	2	34	36	5.55
	Female	5	4	9	55.55
	Total	7	38	45	15.55
Diabetes mellitus	Male	15	18	33	45.45
	Female	8	14	22	36.36
	Total	23	32	55	41.88
Gangrene	Total	30	70	100	30.0

For years the profession has been cognizant of the evils that follow trauma in diabetic as well as in the senile cases. Patients have always been cautioned against ill-fitting shoes, abrasions, cuts, calluses, ingrown toe nails, and any form of injury that would lead to an open or abraded wound. Poor circulation undoubtedly through poor nourishment favors faulty or non-union of such wounds in the aged but while this is true of the patients

in this class, it is vastly more important as an etiological factor in those afflicted with faulty metabolism plus faulty circulation, as in diabetes. A study of Table IV will show that while trauma occurred more often in women in the senile series and more often among men in the diabetic, that the proportion (41.8 to 15.5) was nearly three times as great a factor in diabetes as in arteriosclerosis as the primary cause of gangrene. The percentages of trauma in each sex in the total series of cases are 17 cases of trauma among men, 24.6 per cent, which is 17 per cent of the total series; among the women there were 13 cases of trauma among 31 cases, 41.93 per cent in their sex which is 13 per cent of the total.

TABLE V.—SCLEROSIS AS A FACTOR IN GANGRENE

Disease	Sex	Present	Absent	Total	Per cent
Arteriosclerosis	Male	36	0	36	100
	Female	9	0	9	100
	Total	45	0	45	100
Diabetes mellitus	Male	22	*11	33	66.66
	Female	14	*8	22	63.63
	Total	36	19	55	65.45
Total gangrene	Total	*81	*19	100	81.0

*In diabetic patients no notation is recorded regarding the arterial condition.

In supporting the authors' beliefs and those of others that the local circulatory condition is a vital factor in the gangrene that occurs in diabetic patients, we would like to call attention to an analysis of the arterial condition of such patients among our series. Of the 55 cases of diabetes the records show that arterial sclerosis was present in 36 cases, 66.6 per cent. In the other 19 cases no mention was made of its presence, some of them dated back to 1903, and it was therefore impossible to secure accurate data. Inasmuch as gangrene in diabetes (see Table II) occurs about 5 years earlier than in senile arteriosclerosis and 66.6 per cent of the cases in which the condition of the arteries was recorded showed arteriosclerosis and 100 per cent of all pathological and X-ray examinations made showed it to be present, it would appear that there can not be any question but that the local arterial condition plays an important part in the causation of gangrene of the extremities in diabetic patients, and is therefore quite analagous in this respect to the senile form of gangrene. Could the other 19 unrecorded cases have been studied as closely as the present ones are, it is quite likely that the average of 66.6 per cent would be increased. Coller and Marsh (3) in 20 cases of gangrene of the lower extremities in diabetic patients found no moderate arteriosclerosis but 15 cases, 75 per cent, of marked sclerosis in uninfected cases at an average age of 64.6 years. In the other five infected cases, average age 61 years, there was marked arteriosclerosis (100 per cent).

RENAL CONDITIONS

Regarding albumin and casts occurring in diabetes, Joslin (10) remarks: "As a rule when albumin appears the percentage of sugar falls, even though the percentage of sugar in the blood remains high. From the time of Kuelz the irritation of the kidneys in the first stages of diabetic coma has been observed. 'Showers' of casts may occur at the beginning of diabetic coma. They may appear at times when the albumin amounts to the slightest possible trace. Casts in the urine, even in showers, do not necessitate the development of fatal coma." Again he remarks "Albumin is frequently observed in the urine of diabetic patients but actual Bright's disease is practically unknown except in cases past 50 years of age. It appears safe to assume that diabetes does not lead to the type of nephritis we include under the term Bright's disease. The association of the two diseases in the latter part of life is not uncommon, but the underlying cause of both appears to be the arteriosclerosis of advancing years."

TABLE VI.—PERCENTAGE SHOWING ALBUMIN AND CASTS

Disease	Sex	Series	Albumin	Per cent	Casts	Per cent
Arterio-sclerosis	Male	36	18	50.0	9	25.0
	Female	9	5	5.5	4	44.4
	Total	45	23	51.5	13	28.8
Diabetes	Male	33	19	57.8	11	33.3
	Female	22	14	65.5	6	27.3
	Total	55	33	60.0	17	30.9
	Male	69	37	53.6	20	28.9
	Female	31	19	61.3	10	32.3
	Total	100	56	56.0	30	30.0

TABLE VII.—COMPARISON OF HYPERGLYCÆMIA IN RECOVERIES AND FATALITIES

Sex Outcome	Male			Female			Both Sexes		
	Recovered	Died	Both	Recovered	Died	Both	Recovered	Died	Both
Average age	59.3	59.33	59.315	55.77	56.44	56.11	57.42	57.88	57.71
Average blood sugar	209.69	301.8	238.79	304.7	251.0	277.89	253.2	276.4	258.3
Number of cases	13	6	19	9	9	18	22	15	37

Our own experience tends to confirm this and also shows that, for a group of people who are relatively younger, there is more renal irritation, aside from but perhaps due to the glycæmia, in diabetes than in arteriosclerosis (Table VI).

Of the 100 cases, 56 per cent showed albumin and 30 per cent casts. The diabetics showed a higher percentage (60 per cent) than the seniles (51.55 per cent) of albuminuria and for casts, 30.90 per cent as compared with 28.8 per cent. The proportion seemed to coincide.

HYPERGLYCÆMIA

Of the 55 cases of gangrene occurring in diabetes 37 occurred after blood chemistry had become well established and the above figures therefore represent 67 per cent of the cases. Among the 37 in which blood sugar estimations were performed, 15 died with an average of 268 milligrams of sugar and 22 recovered with an average of 248.59 milligrams. The average for all male cases was 238.79 and for females 277.89. Of the 15 deaths that occurred, 6 were in males with an average of 301.83 milligrams and 9 were in females with an average amount of 251 milligrams.

If the above relations hold true for cases other than those of the author's series it would appear that, in men, the percentage of blood sugar is lower than in women (238:277) but, though it is lower, the males withstand a higher hyperglycæmia (301:251) than the females before succumbing. Vice versa, the women have a higher average of hyperglycæmia (277) and it takes less (251) to prove fatal. Added to this, the female dies younger (56.4 years) with less sugar (251) while the male dies at an older age (59.3 years) with more sugar (301).

Compared with the findings in the sex-age group it would appear that gangrene in diabetic females is much more serious than in the opposite sex and that such cases deserve more careful observation with a view to immediate operation (emergency, one might say) than the male.

Joslin (Table VIII) believes that the hyperglycæmia difference between decades is slight, though in general, the younger the patient the lower the sugar.

TABLE VIII.—INFLUENCE OF AGE UPON BLOOD SUGAR (JOSLIN)

Age—Years	Number of cases	Average blood sugar per cent
0 to 10	20	0.19
21 to 30	20	0.19
41 to 50	20	0.22
61 to 70	20	0.24
71 +	20	0.22

Regarding the duration of the disease he states that it does not bear a close relation to the percentage of sugar in the blood, though in general there is a slight tendency to a slight rise in the blood sugar. It is so moderate however as to afford little support to the theory that diabetes becomes more severe the longer it lasts (Table IX). This is in regard to uncomplicated cases, of course, for in infections the blood sugar may rise quickly and fluctuate with it.

Coma (10) may or may not increase the percentage of sugar in the blood. If anuria develops, the blood sugar will increase. If the urinary volume is well maintained, the low diet of coma may lead to a fall in the blood sugar, though not to normal. As a rule, the lower the carbohydrate tolerance the higher the percentage of blood sugar. The blood sugar percentage at the time of death from various complicating diseases is not distinctive.

DIET AND INSULIN

As the diet is distinctly a medical problem, the authors refer their readers to standard

TABLE IX.—RELATION OF BLOOD SUGAR TO PROGRESS (GRAY, 10)

Blood sugar	Number of cases	Average years of life
Less than 190	62	1.81 years
200 to 290	90	1.23 years
300 to 390	48	1.13 years
400 to 570	10	0.66 years

works and articles upon the subject, as we believe that this phase of a diabetic's case should be handled entirely by the medical consultant, and that his orders should be adhered to strictly for it is only by the closest and kindliest co-operation of the surgeon and the internist that the most can be accomplished. Of the 55 cases, 50 dieted before and after operation; in 5 cases it was impossible to ascertain if they had previously dieted. These figures were therefore not included.

The administration of insulin, too, should be supervised by the internist while the case is in the hands of the surgeon, so that the patient may receive a uniform and correct medical care throughout. In this connection we submit the following figures regarding insulinized patients for what they may be worth:

TABLE X.—INSULIN IN GANGRENE

Result	No. of Cases			Per cent		
	Recovered	Died	Total	Recovered	Died	Total
Insulin	8	7	15	53.3	46.6	27.3
No insulin	23	17	40	57.5	42.5	72.7

In the limited number of cases (27 per cent) in which it was used, 53.3 per cent recovered and 46.6 per cent died, leaving a difference of 6.7 per cent. In the cases in which it was not used (72.7 per cent), more recovered (57.5 per cent) than died (42.5 per cent), the difference being 12 per cent. Of the recoveries 6.7 per cent were given insulin and 12 per cent were not.

Regarding the time at which insulin was resorted to, it was noted that in the 15 cases, 4 received it only after the operation and 11 were insulinized before and after. Of the former group 6.6 per cent recovered and 20 per cent died. Of the latter group 46.6 per cent recovered and 26.6 per cent died. It would thus appear that insulin should be given before as well as after operation.

Joslin's advice is to use it to enable you to hasten the removal of the gangrenous area. He also believes that the use of insulin makes it possible to operate early, that the treatment of actual gangrene (10, p. 644) demands the closest co-operation between a physician and a real surgeon and that gangrene demands aggressive treatment on the part of the physician and surgeon from start to finish!

Lichty (12) reports 2 cases in middle aged patients with well developed gangrene of the toes in which the use of iletin undoubtedly favored healthy granulations and prevented extensive amputation.

Jones, McKittrick and Root (9) write: "We have experimental (11) as well as clinical proof that wounds do not heal well in the presence of a high blood sugar. While it is true that insulin improves the utilization of carbohydrate and for that reason permits wounds to heal that would not have healed formerly, we must not be led into believing that insulin alone will improve the circulation of the extremities with advanced arteriosclerosis." They (9) give a good outline of pre-operative and postoperative care chiefly for abdominal surgery in diabetes.

LOCATION OF GANGRENE

No significance seems to be attached to the location of gangrene regarding right and left. At first it was thought that various anatomical conditions might favor either the right or left side as a place of choice for gangrene, particularly the right, but an examination of the 100 cases shows that 46 per cent occurred on the right, 45 per cent on the left and 9 per cent bilaterally. Bilateral gangrene was twice as common in the seniles (6 cases) as in the diabetics (3 cases).

TABLE XI.—LOCATION OF GANGRENE

Type	Sex	Right	Left	Bilateral	Totals
Arteriosclerotic	Male	14	7	5	36
	Female	5	3	1	9
Diabetic	Male	16	15	2	33
	Female	11	10	1	22
Both	Male	30	32	7	69
	Female	16	13	2	31
Total		46	45	9	100

TABLE XII.—AREAS MOST FREQUENTLY AFFECTED BY GANGRENE

Area	Arteriosclerosis				Diabetes				Gangrene			
	Recovered	Died	Total	Mortality	Recovered	Died	Total	Mortality	Recovered	Died	Total	Mortality Per cent
First toe	11	3	14	21.4	19	9	28	32.1	30	12	42	28.5
Second toe	0	1	1	100.0	2	1	3	33	2	2	4	50
Third toe	0	1	1	100	1	3	4	75	1	4	5	80
Fourth toe	5	1	6	16.6	0	1	1	100	5	2	7	28.5
Fifth toe	4	3	7	42.8	6	4	10	40	10	7	17	41.1
All toes	5	4	9	44.4	3	1	4	25	8	5	13	38.4
First and second toes	1	0	1	0.0	0	0	0	00	1	0	1	0.0
Second and third toes	2	0	2	0.0	0	0	0	00	2	0	2	0.0
Second and fifth toes	1	0	1	0.0	0	0	0	00	1	0	1	0.0
Outer foot	1	0	1	0.0	0	1	1	100	1	1	2	50.0
Inner foot	0	0	0	0.0	1	1	2	50	1	1	2	50
Heel	0	0	0	0.0	0	1	1	100	0	1	1	100
Sole of foot	1	0	1	0.0	0	1	1	100	1	1	2	50
Leg ulcer	0	1	1	100	0	0	0	00	0	1	1	100
Total	31	14	45	31.1	32	23	55	41.8	63	37	100	37.0

It has often been regarded among some men that gangrene occurring in certain toes, namely the third, fourth, and fifth was more dangerous than in others. With a view toward throwing light upon the occurrence of gangrene in a certain toe due to the obliteration of the circulation of that toe and the relative frequency of certain toes being affected more commonly than others, we have compiled Table XII.

It will be noted that 75 per cent of the cases occurred in certain toes, 17 per cent supposedly in several or more toes, and 8 per cent in various portions of the feet. It is to be questioned whether the points of origin so indicated in the group of 17 per cent are accurate and that whether if they could have been studied from their very inception they would not have been found to have originated primarily in one of the five digits and thus have augmented the group of 75 cases which are definite as to their origin. Taking this group as an accurate one it would appear that the most common sites for the origin of gangrene in the lower extremities, whether due purely to arteriosclerosis or to diabetes superimposed upon arteriosclerosis, are, in order, the first, fifth, fourth, third, and second toes, respectively, and that most fatalities, if any significance can be attached to location, occurred in the third, second, fifth, fourth, and first respectively.

THE USE OF ANÆSTHESIA IN OPERATIONS

Table XIII represents the anæsthetics used in 133 operations in 100 cases of gangrene of the lower extremities and includes all operative procedures, such as incision and drainage, femoral sympathectomies, amputations, reamputations, etc.

TABLE XIII.—TYPES OF ANÆSTHESIA USED

Disease	Arteriosclerosis				Diabetes				Both			
Result	D	R	U	M	D	R	U	M	D	R	U	M
Spinal cocaine	0	2	2	0	6	0	6	100	6	2	8	75
Novocain	1	1	2	50	3	2	5	60	4	3	7	57.1
Nitrous oxide	4	9	13	30.7	20	27	47	42.5	24	36	60	40
Spinal stovaine	4	8	12	33.3	3	3	6	50	7	11	18	38.8
Ether	4	15	19	21.0	4	4	8	50	8	19	27	29.6
Chloroform	2	2	4	50	0	0	0	0	2	2	4	50
Hyocine scopolamine morphine	1	3	4	25	0	0	0	0	1	3	4	25
Gas-ether	0	2	2	0	0	2	2	0	0	4	4	0
Ethyl-chloride	0	1	1	0	0	0	0	0	0	1	1	0
Total	16	43	59	27.1	36	38	74	48.6	52	81	133	39

D—Died. R—Recovered. U—Used. M—Mortality.

The operations were performed between the years 1903 and 1925. Forty-five cases are taken from the records of the Philadelphia General Hospital and 55 from the University Hospital. In all, 20 different surgeons are included in the series. The lowest number of operations performed by any one surgeon is 1, 2, and 3 and the highest (in this series only) 14 and 16, respectively. It is interesting to note in going over the individual records that the highest mortality occurred with those surgeons who had only a few cases and vice versa, the lowest mortality with those who had the largest number of cases.

Likewise, regarding the administration of anæsthesias, it should be remembered that the technique of administering local and spinal anæsthetics varied with the different operators

and their assistants and therefore was not uniform, and that the general anæsthetics were administered by various trained anæsthetists (physicians and nurses) and a shifting resident staff.

While the analysis does not accurately portray the relative merits of a single anæsthesia, as administered uniformly with a definite technique by a permanent anæsthetist and with the operation performed according to the skill and finished technique of a single operator, it does serve as a representative analysis of what the results may be like in a similar number of cases throughout various sections and hospitals with different operators, technique, etc.

It further goes to show that, if the results are less favorable and the mortality higher than in a similar number of cases performed with a definite technique as worked out by a particular and judicious clinic, it is high time that steps be taken to adopt a procedure which will work for the welfare of those affected.

In this same light it would be only fair to quote Joslin wherein he remarks: "If ether is used it is a good plan to be as rapid and skilled as are the Mayos and to use as little ether as do their anæsthetists. Gas and oxygen and spinal anæsthesia have been shown to be so superior to ether that in the larger hospitals in Boston it is not the custom to employ it (ether) in operations upon diabetics . . . chloroform and ether both produce hyperglycæmia and are harmful. The administration of ether as given at the Mayo clinic by exceptionally skilled anæsthetists, where the operation is performed gently, rapidly and deftly, is quite different from the way it is usually administered. This is typified in Fitz's (4) table in which 36 per cent less ether is given at the Mayo Clinic and in which the period of anæsthesia is 53 per cent shorter."

TABLE XIV.—ETHER IN 100 ABDOMINAL OPERATIONS (FITZ)

Averages per patient	Mayo Clinic	Control Group
Body weight	64.5 kg.	61.3 kg.
Ether, quantity	170 c.cm.	267 c.cm.
Duration of anæsthesia	48 minutes	102 minutes

Gas-oxygen anæsthesia is supposed generally to work well. Joslin finds spinal anæsthesia by far the most satisfactory for amputation of gangrenous legs.

Local anæsthesia—novocain, nerve block—is probably best used as an adjunct to general anæsthesias and shortens the length of employment of the second. One should avoid trauma in its use, and remember that it is an extra burden, locally, for already weakened tissue to carry.

In our own series (see Table XIII) of diabetic cases the relative mortality of the various anæsthetics were as follows: Gas and ether, none; nitrous oxide, 42.5 per cent; ether, 50 per cent; spinal stovaine, 50 per cent, and spinal cocaine, 100 per cent. As there were no deaths from anæsthesia the above mortalities are naturally indirect. Likewise, due to the multiplicity of operators, it does not give a fair comparison of anæsthesia values as would be the case in a single clinic controlled by the best and most rigid technique requirements.

Coller (3) believes chloroform, ether and local anæsthesia should not be used and prefers spinal anæsthesia or ethylene with oxygen.

LEVELS OF OPERATION

The two questions which concern the average surgeon most when he is called to see a case of diabetes mellitus suffering with early gangrene of an extremity is when to operate and at what level amputation had best be performed. With the dry type of gangrene operation may more safely be deferred than in the moist type. The moist type is more apt to be infectious. Infection spells danger.

TABLE XV.—LEVELS OF AMPUTATION

Levels of amputation	Sclerosis			Diabetes		
	Cases	Deaths	Mortality Per cent	Cases	Deaths	Mortality Per cent
Toes to ankle joint	6	2	33.3	13‡	2	15.3
Ankle to knee joint	19	4	21.0	13‡	7	53.8
Knee to hip joint	10	6*	60	11‡	4†	36.3

*Seventh death occurred 2 weeks after healing from chronic myocarditis.
†Fifth death occurred 46 days after healing from cerebral thrombosis.
‡2 bilateral cases (both recovered) making 37 extremities affected in 35 cases.

There is too often the double and dangerous tendency of procrastination as to when to operate and temporizing as to how high to

amputate. A gangrenous toe, in a diabetic, on the surface, appears to be affected in such a limited small area that physicians frequently are astounded when a surgeon succinctly says: "Amputate at the thigh immediately."

Superficially, we say that it appears to be a trivial condition but when a careful pathological examination is made of the amputated extremities (witness the attached pathological reports and the findings of Buerger), it is found that the underlying condition of such extremities preclude the fine end-results one obtains in amputations performed for traumatism, etc. Damaged arteries and veins can not adequately supply tissues which themselves are already undernourished from faulty circulation and metabolism.

The X-ray frequently shows arteries incapable of proper function. The value (10) of the roentgen-ray in reaching a conclusion as to the desirability of operation is considerable. One obtains in this way both an idea of the condition of the arteries, and also of the presence of necrosed or necrosing bone. The damaged hearts, arteries, and kidneys among the patients is of equal importance with the diabetes in provoking the serious results.

It will be seen in a comparison of the mortality in amputated (Table XV) and reamputated (Tables XVII and XVIII) cases that it is higher in the latter in the diabetic cases and for diabetes as compared (Table XVI) with arteriosclerosis.

TABLE XVI.—COMPARATIVE MORTALITIES OF OPERATION

Operations	Sclerosis			Diabetes		
	Cases	Deaths	Mortality Per cent	Cases	Deaths	Mortality Per cent
Amputations	35	12	34.2	37*	13	35.1
Re-amputations	10	1	10	20	10	50

*Two bilateral cases.

Since the mortality is 15 per cent higher in reamputated cases of gangrene in diabetes than singly amputated cases and since reamputations are 5 times more dangerous in diabetes than in arteriosclerosis, it were far better that a gangrenous diabetic extremity be amputated but once and that at a level that would furnish a sufficient blood supply, a minimum of trauma for artificial extremities (a trauma nearly or equally as dangerous as other forms of trauma in diabetes) and preclude further dangerous and needless operations.

By useless and temporizing operations is meant partial amputations of toes, excision of gangrenous patches, incision and drainage of infected gangrenous areas, long intervals between amputations and femoral sympathectomies. Cases D4, 5, 22, 30, and 34 are examples of conservative operations and waiting too long and represent 50 per cent of the deaths that occurred among the reamputated series or 28.3 per cent of the whole.

The authors are of the opinion that high and immediate amputation should in the majority of cases be performed, because the patients are old and stand bed treatment poorly, becoming incontinent and developing decubitus; persistent infection prevents proper diabetic improvement; high amputation, though giving a higher immediate mortality[1] never necessitates reamputation with its added mortality (30 per cent). Further, the high mortality of thigh amputations includes a high percentage of cases that already had been subjected to previous operative insults. This mortality is much lower in experienced hands with gas oxygen anæsthesia.

The high amputation (mid thigh) gives the best wound results, immediate and remote, because the blood supply is better.

The question of a stump for artificial limbs should never be considered in the aged because in an experience extending over a period of 15 years in handling these cases, the senior writer has never been able to induce one of these patients to wear an artificial limb. In fact it is extremely difficult to teach them the use of crutches.

The surgery in these cases should be of the very best and most rapid after medical preparation. With a minimum amount of gas oxygen and without a tourniquet, the limb should be removed by the transfixion method with long anteroposterior flaps. Should the tissues not bleed freely the amputation level should be carried higher until free bleeding is encountered. It is well to obtain permission

[1] See cases marked † in Table xviii.

to do this, in those patients who demand a low amputation. The transfixion method is the most rapid and at the same time results in less injury to small vessels, than does the dissection necessary in the shaped flap methods. The flaps should be dropped together over a dry field, and loose interrupted sutures of catgut applied, encompassing the skin, subcutaneous tissue, and superficial muscle sheath. Catgut is used because it is elastic and will give when the tissues swell under a light suture. A rubber wick down to the oozing bone which is kept in place for 24 hours gives best results. The stump is bound loosely and kept warm.

Contrary to some views are Joslin's statements as follows: "In Boston, increasingly often amputation is done below rather than above the knee and in many of the recent cases, so sure are these operators of their technique that the wounds are closed without drainage. It is two years since any anæsthetics, save spinal anæsthesia or gas and oxygen have been employed. During the operation the use of a tourniquet is avoided. The choice of the site of amputation is increasingly in favor of the leg over the thigh. With removal of the leg there is less shock and the opportunity for adjustment of an artificial leg is far better. Of 32 cases operated upon between the years 1916 and 1922 at the Boston City Hospital, the percentage of recovery was 100 per cent for leg amputations (5 cases), 83 per cent for thigh amputations (18 cases), and 27 per cent for foot amputations (7 cases)."

Stetten and Burnheim (19) are to be commended in their energetic treatment of the cases in which they were able to avoid operation. Others less energetic will be less successful. So long as the consulting surgeon agrees that satisfactory progress is taking place, well and good, but, if he is in doubt, operate immediately.

Phillips and Tunnick (16) have had very good immediate results in roentgen-ray therapy of thrombo-angiitis obliterans. Others have attempted femoral sympathectomies, and still others have in mild cases (under diet and insulin for some time previous) claimed good immediate results in amputation of the toes in the dry form of gangrene.

TABLE XVII.—REAMPUTATIONS IN ARTERIOSCLEROSIS

No.	Case No.	Origin of gang. toes	1st Oper.	Result	2nd Oper.	Time after 1st	Result	3rd Oper.	Time after 2nd	Result	Remarks
1	A-1	1st and 4th	4th toe amp.	Gang. ft.	Below knee	6 wks.	Slough	3 inches above knee	3 wks.	Healed 4 wks.	Sclerosis of femoral vessels.
2	A-7	1st and 2nd	2 inches above ankle	Gang. leg	M ⅓ thigh	3 wks.	Sinus				Discharged on 9th day, request of relatives.
3	A-9	4th	Amp. toe	Necrosis	M ⅓ thigh	5 wks.	Healed				Attempt at anastomosis of fem. art. found it v. sclerotic. Hyos., scop. and morph. anæsthesia.
4	A-16	All	Knee, diastic	Slough	M ⅓ thigh	2 wks.	Healed				
5	A-17	Toes	Spon. amp. toes	Gangrene	L ⅓ leg	2 wks.	Infect.	Knee disart.	10 mos.	Healed	Left leg amp. 2 years previously.
6	A-20	1st	Toe amp.	Gangrene	L ⅓ thigh	2 mo.	Healed				2 months to heal.
7	A-22	1st and 2nd	Upper ⅓ leg	Gangrene	Knee joint	3 wks.	Died				Died in 3 days. Chloroform. Myocarditis.
8	A-36	1st and 3rd	All toes	Gangrene	Knee joint	2 mos.	Healed				Recovery.
9	A-44	1st	Fem. sympath.	No infection	Toe debrided	4 days	Gang.	Up ⅓ leg	17 days	Healed	Recovery.
10	A-45	5th right	Amp. 5th toe (R)	Infected							5th toe healed in 2–3 wks.
	A-45	4th left	Fem. symp. (L)	Gangrene	U ⅓ leg	2 wks.	Slough	L ⅓ thigh	18 days	Healed	Discharged 35 days after 4th operation.

10 cases of series of 45 cases, reamputated = 22.2 per cent reamputated. Compare with diabetic reamputations.
24 operations were performed upon the 10 cases, averaging 2.4 operations each.
1 death occurred in the 24 operations which might have been obviated with another anæsthetic.
1 death in 10 cases = 10 per cent mortality of cases. 1 death in 24 operations = 4 per cent operative mortality.
Note.—In all of these cases which were operated upon below the lower third of the femur no reamputations had to be performed.

Note.—In all of these cases which were operated upon below the lower ⅓ of the femur.

TABLE XVIII.—REAMPUTATIONS IN DIABETES

No.	Case No.	Origin of gang. toes	1st Operation	Result	2nd Operation	Time after 1st	Result	3rd Oper.	Time after 2nd	Result	4th Oper.	Time after 3rd	Result	Remarks
1	D-2	5th toe	Toe incised	Gangrene	Low ⅓ thigh	2 days	Died							Died.
2	D-3	1st toe	Toe incised	Gangrene foot	Foot incised	4 mos.	Slough	Up ⅓ leg	11 days	Healed				Recovered.
3	D-4	5th toe	Toe amp.	Plantar abscess	Incised and drained	4 wks.	Gangrene							†Died. Acidosis. Female 34 yrs. old.
4	D-7	1st toe	Toe partially amp.	Gangrene	Amputated toe	3 wks.	Gangrene	Low ⅓ thigh	19 days	Acidosis				†Died 6 days later.
5	D-8	1st toe	Toe amputated	Sinuses	Foot incised and drained	9 mos.	Gangrene	L-M ⅓ thigh	3 days	Healed				Discharged 17 days after 3rd oper.
6	D-15	All toes	Below knee	Gangrene	Low ⅓ thigh	6 wks.	Healed							Discharged 2 mos. after 2nd oper.
7	D-19	2nd toe	Amp. toe	Healed	Amputated 1st toe	4 mos.	Healed							1st toe developed gang. after 2nd oper.
8	D-22	Ulcer, foot	Inc. and drainage	Gangrene	Excision of gangrene	34 days	Died							†Died 2 wks. later.
9	D-23	5th toe	Toe amp.	Gangrene	Incision and drainage foot	25 days								Discharged 16 days, not healed.
10	D-30	Pain in toes	Fem. sympath.	4th toe gangrene	Amputated 4th toe	2nd day	Gang. heel	Heel excised	1 day	Gang.	Low ⅓ thigh	15 days	Acidosis	†Died.
11	D-31	1st toe	Toe, incised and drained	Infection and gangrene	Below knee	24 days	Healed							3 mos. to heal.
12	D-33	Toes and foot, left All toes, right	Upper ⅓ leg Amputated all toes	Slough Infection	Excised stump Femoral sympathectomy	35 days 12 days	Slough Necrosis	Mid ⅓ thigh Mid ⅓ leg	3 days 9 days	Died Slough	Thigh incised and drained twice in 4 wks.			Died 16 days later.
13	D-34	All toes, left	Amputated all toes	Necrosis	Mid ⅓ leg	21 days	Healed							†Died.
14	D-35	5th toe	Foot incised* and drained 3×	Gangrene foot	**M-L ⅓ leg	2 days	Necrosis	Mid ⅓ thigh	2 wks.	Infected	Stump reamputated	52 days	***Healed	*3× in 2 wks. **Junction of mid. and low. ⅓. ***Thigh drained 6 times and skin grafts used.
15	D-37	1st toe	Toe amputated	Infection	Incision and drained	69 days	*							*Not quite healed 5 wks. later on discharge.
16	D-44	2nd toe	Toe amputated	Gangrene	M-U ⅓ leg	2 days	Gangrene	Mid ⅓ thigh	58	Uræmia				Died 3 days later.
17	D-46	Ulcer, foot	Femoral sympathectomy	No improvement	Excised gangrene	3 days	No improvement	Toe amp.	24 days	Gang. foot	Low ⅓ leg	53 days	Healed	Recovered.
18	D-51	1st toe	Incised, drained	Gangrene	L-M ⅓ thigh	9 days	Gangrene							Died 2 weeks from pulm. œdema.
19	D-53	1st toe	Toe amputated	Gangrene	Below knee	30 days	*							*Died. Stump nearly healed. Caught cold, stump became gangrenous; patient died 45 days later.
20	D-54	4th toe	Toe amputated	Gangrene	Below knee	25 days	Healed							

20 cases out of 55 required reamputation or 36.36 per cent. 52 operations (not including left leg of bilateral case), averaging 2.6 operations each.

10 deaths (for cases marked † see paragraph 3 under "Comparative Mortalities at Operation") in 20 cases = 50 per cent mortality cases. 10 deaths in 52 operations = 19.2 per cent operative mortality.

Note.—All cases reamputated had primarily been operated upon below the lower ⅓ of the femur.

The authors, however, are of the opinion that though good immediate results are frequently and apparently obtainable from low level amputations, the best end-results will be obtained in those cases that are immediately given higher amputations thus avoiding an ultimate recurrence of gangrene at a higher level due to arteries and tissues which are incapable of regeneration or maintaining it.

Coller and Marsh (3) noted a lower mortality and better results in their non-infected cases and concur in the general opinion that it is safer to wait longer in the dry than in the moist infectious type. To quote: "In our experience there are two sites at which amputation may be successful. In those cases in which there is gangrene of a toe with a sharp line of demarcation distal to the plantar arch, amputation of a toe usually is successful. The amputation must be done without trauma, no closure attempted and the wound allowed to heal by granulation. Of course, gangrene of the other toes may occur at a later date. If the gangrene extends into the foot either primarily or following a toe amputation, a thigh amputation should be performed. It should be emphasized that the sclerosis involves the entire arterial tree and dissections of amputated legs have shown that the narrowest part of the vessel is often in the first part of the popliteal arteries. Amputations through the leg usually fail to heal because of sloughing of the flaps and are not worth trying. The thigh is selected as the site for amputation because it is the lowest point at which healing is likely to occur, and because the patient is not in a condition to stand a series of anæsthesias and operations."

RELATION OF PRE-OPERATIVE TO POST-OPERATIVE DAYS AND END-RESULTS

A very careful analysis was attempted of all the cases in the series to determine the relation of how long it is safe to wait before amputating gangrenous extremities. It was soon found that this could not be done with sufficient accuracy to warrant its presentation to the profession so that proper inferences could be drawn. The reason for this being that the type of patient and the judgment of the private physician who referred the case for hospital care, varied so widely. Some patients, for example, refused to go to a hospital for care until the gangrene had well advanced to the malleoli and with its consequent infection, even immediate operation was of no avail to save a patient that was already in the late stages of acidosis. Then again in most cases the exact onset of premonitory symptoms and the actual gangrene could not be accurately ascertained.

It may be interesting and illuminating to note that the patients that fare the best and in whom the end-results are superior to those found in all others are those who have been sent to the hospital by their private physicians as soon as the first sign of infection about a toe-nail, callus or blister appeared, and in those cases which while being treated in the medical wards for diabetes developed gangrene of a toe and were immediately seen and thereafter closely observed by a surgical consultant.

The cases of so-called diabetic gangrene treated of late years have been admitted at a much earlier stage, with the result that a much more favorable outcome has resulted. So we are led to hope that even this may be improved upon so that the patients may eventually be admitted at the very inception of their condition.

WOUND RESULTS

The immediate and end-results differ in both the purely arteriosclerotic gangrene cases and those of arteriosclerosis with diabetes mellitus. In the former there is less infection of wounds, less necrosis of tissue, less recurrence of gangrene and more cases of primary union.

TABLE XIX.—WOUND RESULT IN GANGRENE

Wound result	Sclerosis		Diabetes		Both	
	Cases	Per cent	Cases	Per cent	Cases	Per cent
Undetermined—died in 5 days	3	6.6	7	12.7	10	10
Non-infected	25	55.5	23	41.8	48	48
Infected, suppurative, necrotic	12	26.6	18	32.6	30	30
Gangrene of stump	5	11.1	7	12.7	12	12
Total	45	99.8	55	99.8	100	100

Table XIX shows the relations of the above factors except primary union, regarding

which it was found that the percentage in the first type of gangrene was 17.7 per cent and 5.5 per cent for the second.

Obviously, local factors (circulation, local tissue, metabolism and general body metabolism or blood chemical conditions) are less in favor for wound results in amputation among those who have diabetes mellitus.

Our experience regarding closure and drainage of amputation wounds in diabetes tends to confirm the experience of the Boston City Hospital operators in that more wounds (40 per cent) healed when closed without drainage than with any other form of technique used. The relative results of the various methods are shown in Table XX.

TABLE XX.—RELATION OF CLOSURE AND DRAINAGE TO HEALING

Technique used	Wound result	Arteriosclerosis		Diabetes	
		Cases	Per cent	Cases	Per cent
Closed and drained	Healed	10	40	7	25
	Did not heal	15	60	21	75
Closed, not drained	Healed	5	35.7	4	40
	Did not heal	9	64.3	6	60
Not closed, but drained	Healed	1	50.0	4	23.5
	Did not heal	1	50.0	13	76.5
Not closed, not drained	Healed	2	50.0	0	0
	Did not heal	2	50.0	0	0

It will likewise be noticed (Table XXI) that wounds heal more quickly in the non-diabetic than in the diabetic. This may be observed in other surgical conditions in diabetes, carbuncles, fistulæ, incisions, etc.

TABLE XXI.—AVERAGE DAYS FOR STUMP TO HEAL IN GANGRENE

Wound results	Sclerosis		Diabetes		Both	
	Cases	Days	Cases	Days	Cases	Days
Healed in hospital	20	44.6	14	46.8	34	45.5
Not healed on discharge	11	44.0	17	42.2	28	42.9
Not healed at death	14	24.5	24	23.7	38	24.0
	45	38.2	55	35.3	100	36.6

ACIDOSIS AND COMA

Twenty-two cases out of the 55 diabetics developed acidosis, representing 40 per cent of the series. Of this number, 13, 59 per cent, recovered and nine cases, 41 per cent, died. Of the 55 cases of diabetes, 9 cases, 16 per cent, succumbed to acidosis. The deaths from all causes amounted to 24, 43.6 per cent, and as 9 of the 24 deaths were due to acidosis the diabetic mortality due to acidosis was 37.5 per cent.

Since 37.5 per cent of the deaths were due to acidosis, it behooves us to prevent acidosis from occurring by using proper technique, anæsthesia, diet and insulin; by avoiding temporizing operations, and the loss of valuable time before operating; by employing the least number of operations in each case by amputating at a level at which the circulation will be highly sufficient to supply the part adequately and to assure healing; lastly, but not least, by the use of exercises to help the body burn its excess sugar, by employing rigid hygiene and asepsis to prevent infection of the operative wound, and by co-operating closely with the internist from the time the patient first presents himself. Could acidosis have been prevented among the 9 cases of this series, the mortality would have been 27 per cent instead of 43.6 per cent. This should awaken us to the significance of acidosis and cause us to use every effort to prevent its occurrence.

Acidosis is increased by infections. Acidosis when severe frequently terminates in coma and death. It is therefore of primary importance to combat all infections early. Joslin has shown in the figures below the percentage of deaths due to coma at different age periods.

Age period	Total deaths	Coma	Per cent
0 to 15	139	119	86
16 to 30	159	114	72
31 to 50	267	140	52
51 to 83	322	81	25

Graham (7) reports 7 cases of coma in diabetic cases, in which infection was present and was probably responsible for sending the patients into coma. Most of them had had diabetes for some years and their condition was never serious until the advent of the infection. He concludes that in cases of local and general bacterial infection, insulin is much less effective in lowering the blood sugar.

Evidence is presented by Richardson and Leonie (17) that the ill effects of infection in

diabetes are due, not to a disturbance in the kelogenic balance but to an actual reduction in the amount, or proportions, of glucose oxidized.

SURGICAL MORTALITY

Among the cases of arteriosclerosis there were no deaths within 24 hours after operation. In the diabetic cases 2 deaths occurred representing 8.3 per cent of the 24 deaths and 3.6 per cent of the 55 cases. The first (Case 2) occurred in a male of 57 years having nephritis and a septic gangrenous foot, the second (Case 25) in a female, 57 years of age who had been admitted in a semistuporous condition with a septic, gangrenous foot, nephritis, and a blood sugar content of 380 milligrams. Spinal anæsthesia was used but the patient died 10 hours later.

In the cases of senile patients, a certain mortality is to be expected from advanced sclerosis, weakened heart, and damaged kidneys; in the diabetic these factors are increased by faulty metabolism, the ever present danger of infections and the great tendency to acidosis and coma. As an example of this, Fitz found that of 45 operations at the Massachusetts General Hospital, the mortality was 30 per cent and that for 20 patients with infections or gangrene it was 50 per cent but for the 25 non-infected cases it was but 12 per cent.

The advent of an infection lowers the tolerance of a diabetic for carbohydrate (Joslin) and thus increases the severity of the disease —this is an old and clinical fact. An infection makes a diabetic worse and it is rarely possible to keep a patient sugar-free in the presence of an infection, whether local or general. An infection is an increased load for the diabetic to carry and to it he often succumbs. With insulin medication infections are infinitely better borne, but the decrease in tolerance is still manifest. Of general infections, pneumonia heads the list with 52 deaths and influenza claims 23. Of local infections, septic and gangrenous legs account for 36, carbuncles for 9, and acute fulminating appendicitis for 4 deaths. In every case of carbuncle or gangrene, one should have a blood culture before operation; it will frequently be found to be positive.

The following paragraphs from Joslin's *Text Book on Diabetics* are illuminating and should ever be borne in mind by the internist as well as by the surgeon.

"Diabetic patients stand in need of the surgeon far more than the same number of non-diabetics or those suffering from most other chronic diseases. As there are more than a million diabetics, more or less, in the country today, the surgery of the diabetic becomes an everyday problem. The frequent occurrence of gangrene and carbuncles is the chief reason for diabetic surgery.

"The factors which favor surgical success in diabetes are first of all an early diagnosis and an early decision to operate. If surgical delays are dangerous under ordinary circumstances, in diabetes they are diastrous.

"The patient should be treated for the operation rather than for the diabetes. Get him successfully through the operation first, and then if you like, treat him for the diabetes the rest of his life. If you treat him first for the diabetes and second for the operation, the duration of that case of diabetes is apt to be brief.

"If the beginning of gangrene were as noisily ushered in as an attack of biliary or renal colic the results of treatment would be far different. Death from gangrene today is usually the result of procrastination on the part of the physician and the patient, and in the past was often associated with the inauguration of a fat-protein diet and ether anæsthesia. Surgery often receives, but seldom deserves, the blame of a fatal issue.

"Everyone knows the risk run by the old man with a broken hip, who is forced into bed. The diabetic with a gangrenous toe runs still more risk, because in addition he needs more exercise to help burn up his sugar. Deprive him of it and his disease gets worse. Therefore, teach him a set of movements to perform whenever the clock strikes the hour. Show him how to protect his lungs by long breaths and turning over in bed. In short keep him busy getting well.

"But what I consider of far more importance is the number of procrastinating cases of mild infections in mild diabetics, chiefly in their lower extremities, which frequently

prove fatal. These conditions develop at a time in life when diabetes is mild and why should they so frequently be fatal? Consider with what these mild cases of diabetes have to contend. Handicapped by a lingering infection which only too often is allowed to continue for months with kidneys less efficient for throwing off the attack of acidosis; deprived of exercise—that proved stimulus to sugar consumption—for whoever heard of a poor old gangrenous diabetic taking exercise, these patients frequently meet a fourth enemy in the anæsthesia. Is it any wonder that a formerly innocent disease becomes more virulent and the victim dies of coma? There is no doubt in my mind but that if such cases had been treated vigorously even with the diabetic methods of a few years ago, a large percentage of the legs amputated might have been saved.

"All are well aware that if a diabetic patient has gall stones to be removed he instantly commands the services of the leading surgeon on the senior staff, but if a diabetic patient has a sore toe, there is no house officer too young to dress it, until a few weeks later if the patient survives that long, the surgeon in the amphitheatre amputates the thigh. No matter how trivial the ailment, secure the very best surgical skill for a surgical diabetic."

EXERCISE IN DIABETES

It has been proved that physical activity decreases the blood sugar content. Gordon and others (6) were able to obtain very good data concerning this factor from the examination of marathon runners. Hodgson (8) advises that diabetic patients be kept mentally indolent and physically active. This is well illustrated in cases 1889 and 22 of Joslin's series in which the first, while taking insulin walked 10 miles a day and occasionally thereby accelerated an *hypo*glycæmia reaction. The second case (a Harvard professor) was conscious of this fact regarding his periods of well being and himself remarked: "mental work makes sugar, manual work burns it up."

Sakaguchi (18) found the blood sugar lowered by exercise. Nehring and Schmoll concluded that unusual activity in diabetics was also at the expense of glycogen (Van Noorden, 22, cites differences) from the fact that it is possible in many instances to reduce the sugar excretion by controlling the muscular activity.

With such a simple procedure as exercise at hand even if it is only lifting weights in bed, movements carried on by or under the instruction of a physiotherapist, or deep breathing, we should take advantage of the benefits it yields and, coupled with all other measures do not one but all things at our command to lighten the load of the diabetic and help him burn up his excess of sugar.

SUMMARY

1. The series comprise 45 cases of arteriosclerotic and 55 cases of diabetic gangrene of the lower extremities which have been amputated.

2. The two types are presented together to show their common and dissimilar points, that both are similar regarding circulatory unbalance, with an added local and general faulty metabolism in the diabetic cases.

3. One-fifth to one-fourth of all diabetics die of gangrene. It therefore behooves the profession to treat such complications correctly and energetically.

4. The fifth and sixth decades are the danger periods. Females appear to die 3.5 years earlier than males.

5. Diabetic gangrene appears a decade (average) before the senile type.

6. The senile type is more common in men, the diabetic type somewhat more common in males than in females.

7. Females die earlier in the disease (diabetes) than males and likewise earlier (1 decade) in life.

8. Trauma, even slight, is an important factor in the causation of gangrene in diabetics.

9. The examination of 100 per cent of the arterial trees of diabetic gangrenous extremities, at operation, autopsy and by the X-ray, show the arteries to be sclerotic. Obviously, recurrence of gangrene is apt to occur when operations are performed through, rather than above, diseased arteries.

10. Renal irritation (albumin and casts) is more common among the diabetic than among the senile cases.

11. Females appear to die younger with a lower hyperglycæmia than males who live longer with a higher blood sugar content.

12. Insulin and diet should be used before and after operation, when possible, but operation should first be performed in the majority of cases.

13. No importance is attached by the authors to the location of the origin of gangrene (i.e., right or left, first or second toes, etc.) as it is a question of arteriosclerosis higher up.

14. The choice of anæsthetics appears to be gas-oxygen, short ether, and spinal.

15. Operate early and high, with less thought of the stump and artificial limb than of reamputation and its high mortality.

16. Wounds should be closed with loosely interrupted catgut suture and a rubber wick for 24 hours.

17. Patients should be sent to the hospital when the first sign of infection develops about a toe nail, blister, abrasion, etc. rather than after gangrene has made its appearance.

18. The closest co-operation between internist and surgeon should govern the treatment of the case.

19. Early and non-temporizing operations should be the rule and not the exception.

20. Severe infection spells acidosis. Severe acidosis spells death.

21. The operative mortality in senile cases, was nil, in diabetic, 3.6 per cent.

22. Mental work produces sugar, physical work burns it. Exercise even in bedridden patients must be insisted upon.

23. Diabetics are to be continually advised and warned regarding hygiene and care of the extremities.

This series leads us to advise proper medical preparation, early, high amputation, done with speed and care, under careful gas oxygen or short ether anæsthesia, closing the wounds with loosely applied, elastic sutures.

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SUBACUTE ILEOCOLIC INTUSSUSCEPTION SECONDARY TO CARCINOMA OF THE ILEUM

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CARCINOMA of the small intestine is rather infrequent. It occurs in about 3 per cent of all carcinomatous conditions of the entire intestinal tract (3). There are three common sites for carcinoma of the small intestine: the duodenum, jejunum, and ileum, the duodenum being the most frequent site of election, while the ileum appears to be the site least frequently attacked. The reverse is true of sarcoma when it occurs in the intestinal tract (1). When duodenal carcinoma does occur it is usually found at or in the vicinity of the ampulla of Vater in 70 per cent of cases.

In 41,858 necropsies performed at the Vienna General Hospital, 3,585 were cases of carcinoma; of these, 343 cases were in the intestinal tract and only 11 in the small bowel (6). Judd states that carcinoma of the intestine has occurred 24 times in the small intestine as compared with 1,822 times in the large bowel and rectum, and 1,689 times in the stomach (5).

Intussusception is the cause of intestinal obstruction in one-third of all cases (8). Acute intussusception occurs most frequently in infants and young adults, being the most common cause of obstruction during this age. There are four chief varieties of intussusception: ileocæcal, in which the ileum and ileocæcal valve passes into the cæcum; colic, in which the large intestine is prolapsed into itself; ileal, in which the small intestine is prolapsed into itself; and ileocolic, in which the ileum passes through the ileocæcal valve into the cæcum. The ileocæcal type is the most frequent, while the ileocolic is least frequent. Rushmore states that in 237 cases of intussusception, 140 were of the ileocæcal variety and only 31 of the ileocolic type (8).

Rose and Carless state that the ileocæcal variety of intussusception occurs in about 44 per cent, while the ileocolic variety is found in about 8 per cent of cases (7).

Chronic intussusception occurs more frequently in adults and the aged, the onset being gradual and the course varying widely in its symptoms. The etiological factor in chronic intussusception is usually neoplasm, foreign bodies, cicatricial contractions or bands, and fæcal impactions. Of these, neoplasms and fæcal impactions are the most frequent causes found.

The symptoms of acute intussusception are well known and are very different from those due to chronic intussusception. The patient becomes suddenly ill, is seized with severe abdominal pain and almost thrown into a state of shock. The pain is usually diffuse throughout the abdomen and followed by vomiting. Absolute constipation is not the usual rule; diarrhœa and blood-stained fæces associated with tenesmus are very common. These symptoms lead to collapse and death of the patient if interference and relief is not afforded promptly.

The symptoms of chronic intussusception are usually very gradual in onset and not so stormy. The patient complains of intermittent attacks of colic-like pain, which usually becomes more severe and intense as the course of the disease progresses. Vomiting may or may not be present, the bowels may have no abnormal action, or may at times develop tenesmus. The condition continues for weeks unrecognized until either discovered accidentally at operation, or, in the minority of cases, diagnosed before operation. Gruner and Fraser have reported two cases of symptomless tumors occurring in the ileum (4).

REPORT OF CASE

Subacute ileocolic intussusception secondary to carcinoma of ileum. H. G., male, aged 35 years, white.

Chief complaint. Patient complained of cramps which were generalized throughout the abdomen and had been present for 2 weeks. The cramps occurred daily at 11:30 a.m. and ceased between 5:00 and 6:00 p.m. The pain usually made its

Fig. 1. Showing the umbilicated tumor arising in mucous membrane of the ileum.

Fig. 2. Microphotograph (low power) of tumor, infiltrating entire thickness of intestinal wall.

appearance about 4 hours after the morning meal. Because of the onset of the pain, this was the only meal he would eat each day. His bowels moved every day, he was not nauseated, and did not vomit; he had no urinary symptoms, and had noticed no loss of weight.

Physical examination. Temperature was 99; pulse, 80. The examination of head, neck, and chest was negative. The abdomen showed no visible peristalsis, no definite points of tenderness, no masses; no rigidity of abdominal muscles. Rectal examinations were negative.

Diagnosis: Undetermined. Patient is to be observed and to be seen the next day. Forty-eight hours later the patient was seized with a very severe attack of pain. A colleague, called in the emergency, made a diagnosis of appendicitis and advised immediate operation. The patient desiring further consultation came to my office. He stated that he had been free from cramps during the previous day, but that today he commenced having the usual pain following his breakfast, the pain reaching its maximum in the afternoon. The pain was colic-like and seemed

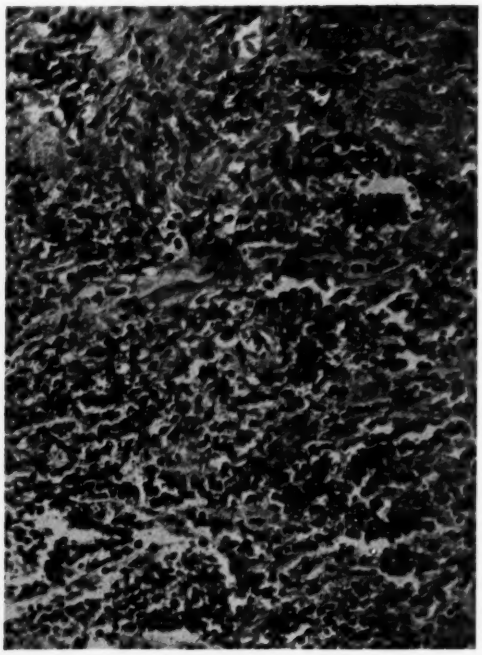

Fig. 3. Microphotograph (high power) of tumor showing numerous mitotic figures.

to center chiefly in the right side. There was no nausea or vomiting; the bowels moved very well that day.

Physical examination. Temperature was 99.4; pulse 90; head and chest negative. On inspection of the abdomen we found a definite tenderness over McBurney's point and rigidity of the right rectus muscle. No visible peristalsis. On deep palpation a mass the size of a small fist could be felt in the right lower quadrant. This mass was tender and slightly movable. Rectal examination was negative; urine examination negative; white blood cells, 9,000.

Diagnosis: appendiceal abscess. Diagnosis confirmed by Dr. Lister Tuholske. Hospital advised but refused.

Five hours later the pain had become so intense that the patient had to be transported to the hospital. On admission the physical findings were the same as above. Laboratory report showed: urine, negative; white blood cells, 12,500. Diagnosis of appendiceal abscess was confirmed by Dr. M. G. Seelig, who advised immediate operation.

Operation. Through a right rectus incision, the peritoneum was opened. No free fluid was found. A normal appendix was delivered into the wound. The appendix was removed and the abdomen explored. A mass the size of an adult's fist was felt in the region of the ascending colon. It seemed

at first to be a retroperitoneal lipoma because, in consistency, it was soft and, in outline, lobulated. Further investigation disclosed that the mass was within the lumen of the ascending colon, and consisted of ileum which had entered the intussuscipiens through the ileocæcal opening. Reduction was accomplished with some difficulty on account of the œdematous bulk of intussuscepted small intestine. About 12 inches of this intussuscepted bowel was released. There was a hard flat tumor about 1.5 inches in diameter, occupying the surface of the intussuscepted bowel, opposite the mesentery. The center of the tumor was umbilicated (Fig. 1). This tumor was situated near the cæcal end of the intussuscepted bowel. There were no visible or palpable lymph glands. A diagnosis of malignant tumor, probably carcinoma, was made and intestinal resection was decided upon. About 12 inches of ileum were resected and an end-to-end anastomosis was made.

Convalescence was uneventful, the patient leaving the hospital on the eighteenth day.

Microscopical examination. The pathologist, Dr. Ives, reported the following: "Specimen revealed a portion of bowel, 10 inches in length. There is a tumor in the wall which apparently involves its entire thickness (Fig. 2). It is button-shaped, 25 millimeters in diameter, and its average thickness is about 9 millimeters. Section of the mass shows a cellular tumor with little stroma. The cells are large and epithelial-like with numerous mitotic figures (Fig. 3). Diagnosis: undifferentiated carcinoma of solid type."

Subsequent course. Patient was given deep X-ray treatment by Dr. Schnoebelen. When seen on April 1, 1926, twelve months after operation, patient stated that he felt well except for a backache (diagnosed as a spondylitis by Dr. P. Hoffman). He weighs 170 pounds, his appetite is good, and his bowels move every day.

On fluoroscopic examination the roentgenologist, Dr. Schnoebelen, reported the following: "Radioscopic examination of the colon shows: Twelve hours after barium meal, a small amount of barium is found in the terminal ileum, the cæcum is partially filled, and a small amount is present in the ascending colon. Barium enters the rectal pouch in the usual position. The sigmoid raises up well out of the pelvis and is not redundant. The entire descending colon is well filled, about 2.5 centimeters in width. The splenic flexure is in the usual position. The transverse colon is well filled, slightly redundant, and crosses the abdomen below the umbilicus, 3 centimeters in width. The hepatic flexure is in the usual position. The ascending colon is well filled, 3 to 4 centimeters in width. The cæcum is well filled with barium and is smooth. Barium is noted passing through the ileocæcal valve; there is no evidence of defects or diverticula; no spasticity or unusual redundancy. Conclusion: X-ray negative."

Epicritical remarks: This case is unusual and interesting because it deals with carcinoma of the small bowel in a young individual and because the intussusception that resulted ran a course strikingly like acute appendicitis, without any clinical signs of intestinal obstruction, despite the fact that at operation it was clearly demonstrated that the ascending colon was completely blocked.

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BRANCHIAL FISTULA—ITS CLINICAL RELATION TO IRRITATION OF THE VAGUS[1]

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THE uncertainty surrounding the origin of branchial fistula has given rise to a great deal of discussion. This has been of a theoretical character, for no acceptable proof has been offered that the branchial arches in the human behave in the same manner as do those in lower animals. Monographs in French, German, and Latin are quite numerous, including those by Hunczowski, Dzondi, Asherson, Heusinger, Cusset, Quénu, and Wenglowski. In this country, Whitacre has produced an excellent practical consideration of the subject, and Coplin a beautiful description of the microscopic pathology, Coplin laying especial emphasis on the lymphoid elements in the wall of the tract, which had previously been observed by Sulicka, and later by Broca, Salin, and Monod. Considering the vast amount that has been written, there have been very few references to symptoms of nervous origin in connection with branchial fistula.

The following case of branchial fistula, with clinical symptoms of vagus nerve irritation which were relieved promptly by excision of the tract, stimulated me to consider the subject at some length.

R. S., schoolboy, American, referred by Dr. Manahan, aged 5, gave as a chief complaint a discharging sinus in the right side of the neck.

When the child was born, the mother noticed in the front part of the right side of the neck a small, reddish, raised area, about the size of the head of a pin. She paid no attention to it until 2 years ago, when the swelling opened and discharged a small amount of mucoid material. After that time the opening in the neck closed and opened intermittently, the discharge being more profuse when the child had a cold. Occasionally a small swelling formed about the opening. For 2 years the boy had a dry, hacking cough, which was more pronounced at night, and when the sinus was not discharging.

The child was of breech birth and was breast fed. He had bilateral otitis media in infancy. Tonsils and adenoids were removed 1 year ago to cure his cough but without any remedial effect. He had chicken-pox 2 years ago. The family history is negative.

Physical examination showed the patient active and not acutely ill. He wore glasses for slight strabismus. Ears, nose, throat, larynx, heart, lungs, and extremities were negative.

Surgical condition: In the right cervical region, at the anterior border of the sternomastoid, about 3 centimeters above the sternoclavicular junction, was a soft, non-tender, fluctuating, reddish, cystic mass, 3 millimeters in diameter, with a red dot in the center, which was closed. The cystic mass became a little larger on coughing. No attempt was made to probe, or to inject any fluid into it to determine its course or patency. A diagnosis of branchial fistula was made and operation advised.

Operation, May 7, 1923. Ether anæsthesia.

An incision 3.5 centimeters long was made over the anterior border of the sternomastoid, and the cystic mass excised. There was a distinct tract which went through the platysma, the sheath of the sternomastoid, and the carotid sheath, between the carotid artery, internal jugular vein, and vagus nerve. It was in intimate contact with the vagus for a short distance, and slightly adherent to it at one point. It then coursed obliquely upward and backward toward the pharynx, but a probe in the tract could not demonstrate an opening into the pharynx. The pharyngeal end was very thin and friable.

The sinus tract was carefully dissected out by blunt and sharp dissection, after the sternomastoid, carotid artery, and internal jugular vein had been retracted. At the pharyngeal end, the tube tore off. The remaining tissue was carbolized. Plain catgut was used to close the platysma and fascia; subcuticular plain catgut for skin.

The specimen is 3 centimeters in length and ½ centimeter in diameter. The outer surface is uneven and the cut surface shows a lumen containing mucoid material surrounded by an elastic wall. The microscopic examination shows a tubular structure lined by stratified flat epithelium. There is a marked subepithelial inflammatory cell infiltration. The surrounding muscle tissue is markedly œdematous.

Subsequently, Dr. A. Purdy Stout was requested to see the slide and to make a report with special reference to the presence of nerves in the wall of the tract. The following is his report:

A number of slides were prepared from the paraffin block submitted. They all show essentially the same picture. There is a very small fistulous tract lined with stratified squamous epithelium with a great deal of lymphoid tissue immediately surrounding. The tract passes through a mass of striated muscle. This is supplied by at least three groups of

[1] Read before The Section of Pediatrics, New York Academy of Medicine, November 12, 1925.

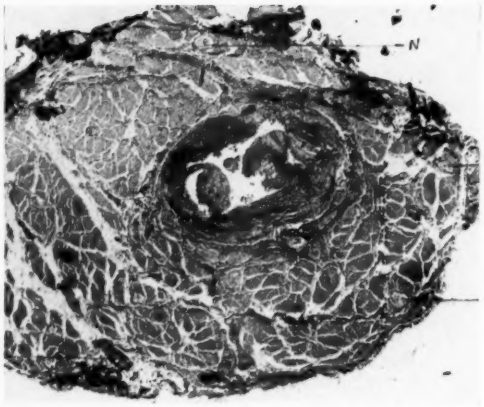

Fig. 1. R. M. A low power microphotograph showing in the center the fistulous tract lined partly with squamous epithelium and partly with infected granulation tissue. In the surrounding striated muscle can be seen four small bundles of nerves (*N*) accompanying vessels. No other nerves were found.

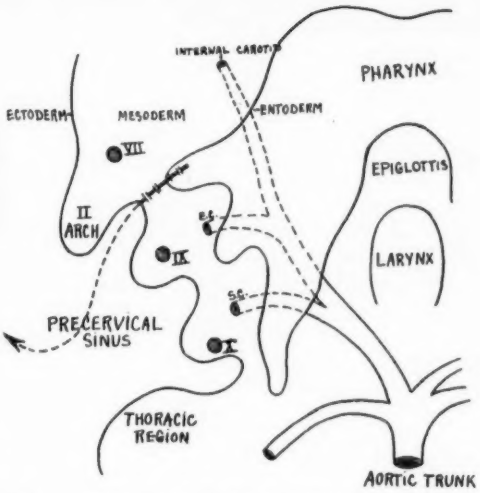

Fig. 2. Embryo of mole showing relation of nerves and arches, the site of the precervical sinus, and the path of a complete branchial fistula (-----) with the break through the mesoderm into the pharynx (— — —). (Schematic cross-section, after Rabl; drawn by Dr. J. Alonzo.)

small vessels and accompanying these in each case a very small bundle of nerve fibrils. On account of the type of fixation and embedding, it was not possible to demonstrate whether these were myelinated or not, but the assumption seems reasonable that they are simply nerve twigs supplying the striated muscle. No nerve bundles could be found in the connective tissue immediately about the fistulous tract (Fig. 1).

Progress notes: The cough stopped on the day of operation and the wound healed by primary union.

Follow-up notes: December 3, 1923. The wound is hairline in character. There has been no recurrence of swelling, discharge, or cough.

May 10, 1925. End-result excellent. No cough.

November 10, 1925. No recurrence. No cough.

The history of branchial fistula in this case is definite, with a hacking, unproductive cough, which persisted for 2 years, during which time discharge from and inflammatory reaction in the branchial fistula took place. The cough was not relieved by a tonsillectomy or by medical measures. At operation the wall of the tract was found in contact with the vagus and slightly adherent to it at a point where the sensory fibers to the larynx are. A chronic irritation of this section of the nerve by the inflammatory sinus tract produced a cough which was stopped after operation. The tract was not injected prior to operation to demonstrate the possibility of a pharyngeal opening, and investigation at operation failed to disclose such an opening. There was a lack of recurrence. These facts would seem to eliminate the possibility of a cough produced by intermittent discharge into the pharynx.

The clinical symptoms, the findings at operation, and the end-result in this case emphasize the importance of a correct understanding of the relation of branchial fistula to irritation of the vagus. Such an understanding necessitates a knowledge of the embryology of the branchial arches and their nerves. The conclusions of Sutton and also of Cusset, who have investigated this subject, is that there are, in the embryo of the lower animals, five branchial arches separated by five clefts and that if any of the lower clefts is not obliterated by the growth of the corresponding arch, an abnormality, such as a branchial fistula, will result. These observers have assumed that the situation in the human embryo is analogous. Whether or not this assumption is correct, two conditions in the anatomy of branchial fistula cannot be explained under this theory. Clinical observations have shown, first, that the external opening of the fistula occurs in several different

positions with respect to the midline of the neck; and second, that the internal opening in complete fistula always occurs in the supratonsillar fossa, as brought out by v. Kostanecki and v. Milecki in an exhaustive investigation of 125 cases in the literature.

Rabl's explanation of the embryological structure is more satisfactory. He pointed out that in the early embryo there are four branchial bars numbered from above down. Each is a protrusion with an ectodermal furrow above and below. These furrows do not normally communicate with the entodermal furrow, which springs from the pharynx. The subsequent development of the mesoderm in the pouches and its circular segmentation produce the branchial arches. The two sides of the first, or mandibular arch, meet to form the mandible. The second, or hyoid arch, grows downward and in front, rapidly, invading the entire future cervical region. A recess, known as the precervical sinus, which develops from the overgrowth of the second branchial arch, accompanied by the atrophy and posterior displacement of the two arches below, is normally obliterated. The potential space which occurs from the apposition of ectoderm against ectoderm is obliterated by a disintegration of its cells. The furrow beneath the second branchial arch, which is very deep at its posterior end, persists longer than the other transitory conditions. The future site of the tonsil is at the internal invagination of the entoderm and is on the same level as the second furrow. Normally, in a mammal, there is no such final communication at this point between ectoderm and entoderm as exists in the fish, where such communication produces the gill cleft. The third and fourth furrows gradually become stretched out and flattened, the third becoming the thymus. The fourth is separated from the entoderm by a very thick layer of mesoderm, and a break into the precervical sinus at this point is hardly probable. It is accordingly evident that the level of the second furrow is the logical point at which a fistula may enter into the pharynx.

All the following types of branchial abnormalities become readily understandable:

1. The external opening may be high or low in the neck depending on the downward extent of the growth of the second branchial arch (hyoid arch). In no case would it be above the structures derived from the hyoid arch or below the sternoclavicular junction. The invagination or evagination of the arch determines the external opening with respect to the midline.

2. The blind end of an incomplete external fistula is a continuation of the vestigial remains of the ectoderm of the precervical sinus.

3. If the second arch obliterates the precervical sinus, but the second furrow persists and communicates with the pharyngeal entoderm, an incomplete internal fistula results.

4. A cessation of complete downward growth of the second arch, accompanied by a break through the mesoderm at the level of the second furrow, will produce a complete branchial fistula.

5. If both internal and external openings are lacking and the precervical sinus has not been completely obliterated, a branchial cyst will result, which, because of its epithelial structure, may give rise to a branchial dermoid or carcinoma.

Figure 2 illustrates how an irregular development of the second arch results in a continuance of the precervical sinus which is normally obliterated. This produces various abnormalities, ranging from fistulæ and cysts to monstrosities.

The relation of the various nerves to the arches must now be considered (see Fig. 3, an 8.7 millimeter embryo of a cow). The facial nerve is distributed along the inferior border of the first arch and the superior border of the second. The glossopharyngeal nerve courses along the inferior border of the second and the superior border of the third arches (Huxley). The superior laryngeal branch of the vagus supplies the fourth arch, and the vagus itself passes behind this arch to descend into the thorax (Quénu).

By reason of their location, these nerves, especially the ninth and tenth, may be affected by irritation from inflammatory changes in the tract, undue pressure from retained secretion, or sudden pressure produced by an instrument. It is also possible that these nerves might send aberrant branches to the wall of the tract. Thus, Tourneux speaks of

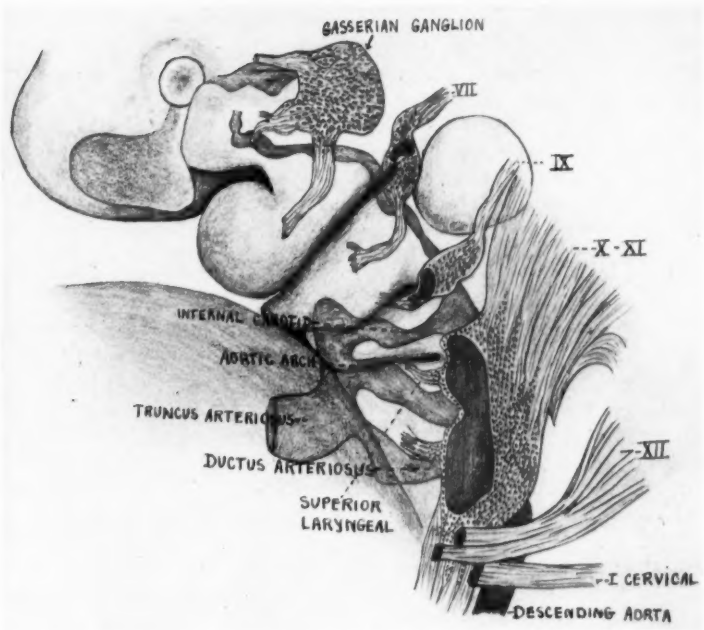

Fig. 3. Lateral view of an 8.7 millimeter embryo of cow with deep superimposed cross section of the blood vessels and nerves under discussion. (From Froriep, drawn by Dr. J. Alonzo.)

the muscular fibers of a fistulous tract being rich in nerve filaments of the glossopharyngeal. Watson, in dissecting a cadaver, found a complete branchial fistula which intervened between the stylopharyngeus muscle and glossopharyngeal nerve, which normally are in close apposition. As it passed behind the fistula, the glossopharyngeal gave off several small nerve twigs to its walls. In connection with this, it should be noted that most external fistulous openings are along the anterior border of the sternomastoid just above the sternoclavicular junction, and as a result contact with the vagus is probable.

The effect of such contact can be appreciated only by a knowledge of the anatomy and physiology of the vagus. In the neck it gives off the superior cardiac branches which arise somewhere between the superior and inferior laryngeal nerves. The inferior cardiac branches arise near the origin of the inferior laryngeal and some of these branches may spring from it. Both superior and inferior cardiac branches pass toward the heart and unite with the cardiac branches from the sympathetic chain to form the cardiac plexus. The last lies on the arch and the ascending part of the aorta, and the inhibitory fibers to the heart have their origin in it. The superior laryngeal nerve sends sensory fibers to the mucous membrane of the larynx. The vagus itself distributes to the lungs two kinds of sensory fibers, inspiratory and expiratory, which act normally on the respiratory center. Gastric motility and motility of the small intestine and part of the large intestine are partly governed by vagal action. The pancreas and gastric glands receive secretory fibers from it.

The intimate anatomical relationship that a branchial fistula may assume with respect to the vagus might, therefore, cause different degrees of irritation. This might further be enhanced by such factors as inflammation, overdistention of the tract with secretion, instrumentation, or manipulation. And the

selective vagal fibers which are affected would produce symptoms such as cough, hoarseness, acceleration of the pulse, extra systoles, alteration of cardiac force, or gastro-intestinal symptoms.

Interesting observations are recorded in the literature of branchial fistula in which some symptoms are clearly those of vagus nerve irritation. Dzondi attributed hoarseness and cough in one of his cases to a communication of the tract with the trachea. We know now that this communication does not occur, for the respiratory bud comes off below the branchial apparatus. Heusinger gives a vivid description of the symptoms in the following case: The patient, a girl of 7, had a tract opening at the anterior border of the sternomastoid. The introduction of a probe for a short distance produced a hacking cough. A thick moustache hair, 8 centimeters long, when inserted into the tract, promptly caused a short cough and hoarseness, and prevented the child from speaking loudly. These symptoms disappeared immediately on withdrawal of the hair. Heusinger assumed that the hair had gone into the pharynx. But that would not produce hoarseness. All the above symptoms can be satisfactorily explained by irritation of the fibers of the superior laryngeal. In another of Heusinger's cases he injected sugar solution into the tract, and attributed the resultant short cough to an inner opening. Fevrier, in the case of an adult male, made some interesting observations. By probing the branchial fistula or by pinching the tract with the fingers, he caused pallor, sweating, and an intermittent pulse. As the tract was manipulated, an unproductive cough of varying severity resulted. The gentlest kind of probing, although painless, also produced a cough which was accompanied by faintness. An injection of a quinine solution failed to show an internal opening. The pain in the ear in this case was probably caused by referred pain along the auricular sensory branch of the vagus, which supplies the external auditory canal. Dorion states that if the tract is explored or fluid injected into it, there may be cough, tickling in the throat, hoarseness, aphonia, or fainting. These phenomena disappear when manipulation is stopped. He attributes these symptoms to involvement of the glossopharyngeal. It would seem, however, that they are more satisfactorily explained by irritation of the vagus or one of its branches in the neck. On probing the tract in the fourth case that he reports, nausea and cough were produced. The opening was at the anterior border of the sternomastoid a little below the hyoid. According to Cusset, the probing of a fistula may give respiratory reflexes, such as cough, hoarseness, and oppression. His statement that these phenomena occur only when the "external opening corresponds to the fourth branchial cleft" show his firm belief in the cleft theory of the origin of branchial fistula.

Of course, cough may be produced in complete fistula by a discharge into the pharynx or by the successful probing of the tract. Lilienthal, Whitacre, Whiteford, and Vance report this, and in the presence of a tangible etiological factor it would be hazardous to ascribe the symptom to vagus irritation. However, such irritation may have been present.

CONCLUSIONS

1. Embryological facts show that the branchial arches come into relation with the facial and glossopharyngeal nerves, and with the vagus and its superior laryngeal branch. The vagus is so situated that it is most likely to come in contact with a branchial fistula. Symptoms may also be produced by an independent nerve supply which the tract wall may receive from the nerve.

2. Probing or pinching a tract, or injecting a diagnostic fluid into it, have produced irritative vagal symptoms, cough, palpitation, intermittent pulse, hoarseness, pallor, and sweating. Referred pain may occur along sensory fibers.

3. The case herewith reported, a five-year-old boy with a branchial fistula, gave a history of an unproductive cough for 2 years, unsuccessfully treated by a tonsillectomy and medical measures. At operation the inflammatory, incomplete, external fistulous tract was found adherent to the vagus nerve, and after its excision the cough stopped promptly and did not return in a two and a half year follow-up.

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THE EFFECT OF VARIATION OF HYDROGEN-ION CONCENTRATION ON THE MOTILITY OF HUMAN SPERMATOZOA[1]

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THE problem of sterile marriage justifies the study so far as possible of the physiological mechanisms involved in impregnation. It has long been believed that hyperacidity of the vaginal secretion is detrimental to the motility of the spermatozoa, the reaction of the normal habitat and suspending medium of the latter being slightly alkaline. A successful modification of hyperacid vaginal secretion to one approaching neutrality or to alkalinity has at times been followed by successful impregnation and this fact has supported the hypothesis given above. Accurate studies of the effect of hydrogen-ion concentration on motility of human spermatozoa, however, are not available.

The studies of Loeb, Lillie, and others upon the influence of hydrogen-ion concentration on motility and fertilizing power of the sperm of marine forms has been reviewed by Lillie and Just (4, 1924).

Gray (3, 1915), studying the fertilizing power of the spermatozoa of the male luidia, noticed that the eggs did not become fertilized as usual in sea-water. The addition of a few drops of a decinormal solution of sodium hydroxide ($\frac{N}{10}$NaOH)[2] to the suspension of these motionless spermatozoa in sea-water caused immediately an active movement, and when such "activated" spermatozoa were added to eggs from the same female every egg was quickly fertilized and a large number of healthy larvæ were obtained. The same phenomenon has been observed by Gray on the male asterias glacialis, echinoid, and on arbacia, and by Lillie on nereis.

Gray's observation shows furthermore that spermatozoa from the male arbacia, having been made immotile and inactive by rendering the medium acid with a decinormal solution of hydrochloric acid ($\frac{N}{10}$HCl), regained their motility and fertilizing power when the medium was alkalinized with a decinormal solution of sodium hydroxide ($\frac{N}{10}$NaOH). It is evident from this work that the spermatozoa are very susceptible to the slightest change of the reaction of the medium toward the acidity, while certain degrees of alkalinization secure an active motility and complete fertilizing power. High alkalinity again inhibits the life of the spermatozoa.

Our method has been to study the number of motile spermatozoa and the degree of motility when a drop of freshly obtained human semen was added to four drops of a buffer solution of known hydrogen-ion concentration. The mixture was immediately placed as a hanging drop under the microscope. The observations were completed within 4 to 5 hours from the time of obtaining the semen.

The preparations in different buffer solutions from any given semen contained roughly comparable numbers of spermatozoa. However, depending upon the hydrogen-ion concentration there was an obvious difference in the number of actively motile spermatozoa in the field. The differences are indicated in the tables. Furthermore, in any field the spermatozoa exhibited different degrees of activity; some were immotile, some were vibrating feebly with little or no change in location, and

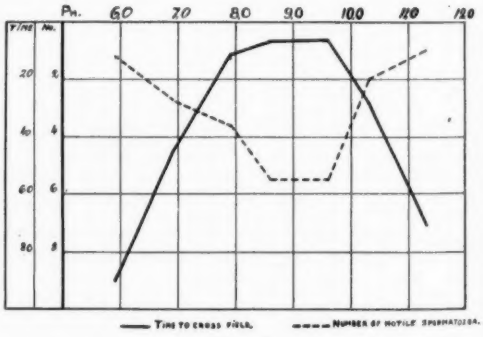

Fig. 1.

$\frac{N}{10}$ = decinormal solution.

[1] From the John Herr Musser Department of Research Medicine and the Department of Urology, University of Pennsylvania.

TABLE I.—$\frac{M}{10}$ CITRATE MIXTURE

	pH of buffer	Number of motile spermatozoa in field				Time to cross field in seconds			
		Fields counted	Max.	Min.	Aver.	Spermat. counted	Max.	Min.	Aver.
Case 1	4.0 5.0 6.0	3	No motion 1	1	1	3	97	59	78
Case 2	4.0 5.0 6.0	3	No motion 2	1	1.5	3	56	39	47
Case 3	4.0 5.0 6.0		No motion						
Case 4	4.0 5.0 6.0	3	No motion 2	1	1.5	3	112	80	96
Case 5	4.0 5.0 6.0		No motion						
Average	4.0 5.0 6.0		1.5	1	1.2		96	47	71.5

TABLE II.—$\frac{M}{15}$ PHOSPHATE MIXTURE

	pH of buffer	Number of motile spermatozoa in field				Time to cross field in seconds			
		Fields counted	Max.	Min.	Aver.	Spermat. counted	Max.	Min.	Aver.
Case 1	5.9 6.9 7.9	3 5 4	1 3 0	1 1 4	1 2 5	3 5 5	87 37 12	68 21 8	77 29 10
Case 2	5.9 6.9 7.9	No motion 4 3	3 0	1 2	2 4	4 5	32 12	18 5	25 8.5
Case 3	5.9 6.9 7.9	3 4 4	2 2 5	1 1 2	1.5 1.5 3.5	4 5 4	88 31 8	67 24 5	77 27 6.5
Case 4	5.9 6.9 7.9	3 4 4	1 4 0	1 2 4	1 3 5	4 4 5	89 42 10	59 18 5	74 30 7.5
Case 5	5.9 6.9 7.9	No motion 4 4	3 8	1 3	2 5.5	5 5	47 15	21 5	34 10
Average	5.9 6.9 7.9		1.5 3 5.5	1 1.5 3.5	1.2 2.2 4.5		77 34 10	74 25 6.5	75.5 29.5 8.2

some were actively traversing the field. The rate at which those actively traversing the field progressed was conspicuously different in buffer solutions of different hydrogen-ion concentration values. With a stop watch the time required to cross the field for a number of these actively progressing spermatozoa in each preparation was determined and is shown in the tables. The observations were made with a No. 1 ocular and 4 millimeter objective (B. and L.).

The buffer solutions used were prepared according to the directions given by Clark (2). We used the following Soerensen buffers: $\frac{M}{10}$[1] citrate (pH = 4.0 to 6.7); $\frac{M}{15}$ phosphate (pH = 5.2 to 7.9); and $\frac{M}{10}$ glycocoll (pH = 8.6 to 12.3), the glycocoll solutions being prepared with Pfannenstiehl's glycin. In addition we used the Walpole $\frac{M}{5}$ acetate buffers (pH = 4.0 to 5.6) and the Clark and Lubs $\frac{M}{5}$

[1] $\frac{M}{10}$ indicates a tenth gram-molecular solution, etc.

TABLE III.—$\frac{M}{5}$ PHOSPHATE MIXTURE

	pH of buffer	Number of motile spermatozoa in field				Time to cross field in seconds			
		Fields counted	Max.	Min.	Aver.	Spermat. counted	Max.	Min.	Aver.
Case 1	5.9	2	1	1	1	1	150		150
	6.9	4	6	3	4.5	5	88	53	70
	7.9	4	2	1	1.5	4	25	10	17
Case 2	5.9	No motion							
	6.9	4	3	1	2	5	72	34	53
	7.9	4	4	1	2.5	5	10	5	7.5
Case 3	5.9	4	2	1	1.5	3	120	90	105
	6.9	4	3	2	2.5	4	76	32	54
	7.9	4	3	1	2	5	8	4	6
Case 4	5.9	No motion							
	6.9	4	3	1	2	4	73	53	63
	7.9	4	5	3	4	4	33	18	25.5
Case 5	5.9	3	1	1	1	3	118	75	96.5
	6.9	5	3	1	2	4	63	40	51.5
	7.9	4	5	3	4	5	12	5	8.5
Average	5.9		1.5	1	1.2		150	96.5	123
	6.9		4.5	2	3.2		70	51.5	60.7
	7.9		4	1.5	2.7		25.5	6	15.7

TABLE IV.—$\frac{M}{10}$ GLYCOCOLL MIXTURE

	pH of buffer	Number of motile spermatozoa in field				Time to cross field in seconds			
		Fields counted	Max.	Min.	Aver.	Spermat. counted	Max.	Min.	Aver.
Case 1	8.6	4	12	6	9	5	8	4	6
	9.6	3	10	5	7.5	6	6	3	4.5
	10.3	4	5	1	3	5	32	8	20
	11.3	4	1	1	1	3	53	35	44
	12.3	No motion							
Case 2	8.6	5	4	2	3	5	7	4	5.5
	9.6	4	8	4	6	5	10	5	7.5
	10.3	4	3	1	2	5	33	18	25.5
	11.3	3	1	1	1	4	80	49	64
	12.3	No motion							
Case 3	8.6	4	5	3	2	5	8	5	6.5
	9.6	4	6	2	4	5	10	5	7.5
	10.3	4	1	1	1	4	31	12	21.5
	11.3	No motion							
	12.3	No motion							
Case 4	8.6	3	8	4	6	5	6	5	5.5
	9.6	4	6	2	4	5	12	5	8.5
	10.3	5	1	1	1	5	32	19	21.5
	11.3	3	1	1	1	3	114	83	98
	12.3	No motion							
Case 5	8.6	4	5	2	3.5	7	11	5	8
	9.6	4	5	2	3.5	5	8	5	6.5
	10.3	4	2	1	1.5	4	56	18	37
	11.3	No motion							
	12.3	No motion							
Average	8.6		9	2	5.5		8	5.5	6.7
	9.6		7.5	3.5	5.5		8.5	4.5	6.5
	10.3		3	1	2		37	20	28.5
	11.3		1	1	1		98	44	71.0
	12.3								

phthalate buffers (pH = 4.0 to 6.0) and $\frac{M}{5}$ phosphate buffers (pH = 5.8 to 8.0). Buffer solutions containing borate appeared to exert a specific inhibiting action on the motility of the spermatozoa and were therefore not employed. The hydrogen-ion concentrations of the buffer solutions were checked by electrometric determinations.

The results of these experiments are shown in Tables I to IV and are summarized in

TABLE V.—SUMMARY

pH	5.9		6.9		7.9		8.6		9.6		10.3		11.3	
	No.	Time	No.	Time	No.	Time	No.	Time	No.	Time	No.	Time	No.	Time
Citrate	1.2	71.5												
$\frac{M}{15}$ Phosphate	1.2	75.5	2.2	29.5	4.5	8.2								
$\frac{M}{8}$ Phosphate	1.2	123	3.2	60.7	2.7	15.7								
Glycocoll							5.5	6.7	5.5	6.5	2.0	28.5	1.0	71.0
Average	1.2	90	2.7	45.1	3.6	11.8	5.5	6.7	5.5	6.5	2.0	28.5	1.0	71.0

TABLE VI

Buffer pH=4.0	Before alkalinization	After alkalinization	
		Number	Time
$\frac{M}{5}$ Acetate	Immotile	5	21′
$\frac{M}{5}$ Phthalate		2	15′
$\frac{M}{10}$ Citrate		4	7′

Table V and in the graph. Below a hydrogen-ion concentration of 6.0 no motion was observed in the spermatozoa. As we progressed toward more alkaline solutions the number of motile spermatozoa and the speed of the most actively motile ones in each preparation increased to a maximum at hydrogen-ion concentration values from 8.5 to 9.5. With still more alkaline solutions the motility again diminished.

It has already been noted that Gray was able by alkalinization to restore motility to certain marine spermatozoa which had been rendered immotile by acid. To test the possibility of this with human spermatozoa we mixed semen with $\frac{M}{5}$ acetate, $\frac{M}{5}$ phthalate, and $\frac{M}{10}$ citrate buffer solutions of a hydrogen-ion concentration of 4.0, using one part of semen to four of buffer solution. In all of these the motility was checked. After standing a half hour the suspensions were titrated with decinormal solution of sodium hydroxide ($\frac{N}{10}$ NaOH) until just alkaline to phenolphthalein and the preparation examined under the microscope. Table VI shows that motility was restored to almost maximal degree. Acidity of hydrogen-ion concentration = 4.0 for one-half hour therefore inhibits motility but does not destroy the capacity for active motility when proper hydrogen-ion concentration is restored.

The extreme susceptibility of human spermatozoa to change in reaction of the surrounding medium must be considered of great importance, and even a weakly alkaline medium (pH 7.5) does not permit the spermatozoa to develop their full activity.

In the normal human female the vaginal secretion is acid and the uterine, weakly alkaline (Braus, 1). The slightest change in the reaction of the uterus toward the acid side, due to disease, might be a cause of sterility.

CONCLUSIONS

1. The influence of the hydrogen-ion concentration on the motility of the human spermatozoa has been studied.

2. The optimum lies between the hydrogen-ion concentration values of 8.5 and 9.5.

3. Change toward acidity causes inhibition of motility, no motility occurring below hydrogen-ion concentration = 6.0. Reactions higher than hydrogen-ion concentration = 10.0 also cause inhibition of motility.

4. Spermatozoa made inactive by rendering the medium acid (pH = 4.0) regain their motility after realkalinization.

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A CLINICAL AND PATHOLOGIC STUDY OF CHOLECYSTITIS AND CHOLELITHIASIS[1]

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INCIDENCE OF GALL-BLADDER DISEASE AMONG NECROPSY CASES

AMONG 612 specimens examined postmortem, 377, 62 per cent, showed grossly visible diseases of the gall bladder. If young persons are omitted, this would indicate that 66 per cent of all those more than 21 years of age who come to necropsy have gall-bladder disease. No higher incidence of gall-bladder disease discovered at necropsy appears in the literature, probably because a relatively high percentage of patients with gall-bladder disease register at the Mayo Clinic. Among 49,659 new patients registering at the clinic during 1922, 2,475, 5 per cent, complained of gall-bladder disease, and 1,075 operations were performed for gall-bladder disease during that year.

Hoffman, statistician for the Prudential Life Insurance Company, computed that 2,887 persons, in a total of 85,147,822, died from gall-bladder disease in 1919, that is, 33 out of every 1,000,000 of the population. Riedel reported that only 5 per cent of 2,000,000 persons had gall-bladder disease. Lichty found that 40 per cent of 1,500 patients with gastro-intestinal complaints had disease of the gall bladder or appendix.

In this series of consecutive deaths at the Mayo Clinic, however, less than 8 per cent (49) were due primarily to gall-bladder disease. Forty-six of the patients had had operations; 35 of these had had stones. The three patients without operations did not have stones.

The majority of persons more than 30 years of age showed some disease of the gall bladder. The youngest patient was a girl of 13 who had grossly visible lipoid in the wall of the gall bladder (Table I).

MINOR GROSS LESIONS

In this series of necropsy examinations at the Mayo Clinic there were no instances of congenital absence of the gall bladder, but at a previous examination here Nagel found one case, that of a man aged 38. Meckel, in 1912, stated that congenital absence of the gall bladder was not so rare. Gay, in 1922, collected a total of 22 cases. None has been reported since. In this series there were no instances of congenital absence, atresia, or reduplication of the bile ducts, but numerous instances of each are reported in the literature. The incidence of minor gross lesions was 8 per cent (Table II).

Among 727 patients operated on for gall-bladder disease, Blalock found 0.2 per cent with diverticula of the gall bladder.

Among 235 macroscopically "negative" gall bladders, there were 86 with microscopic evidence of inflammatory change, indicated by polyps. In 34 of these there were abnormal numbers of polymorphonuclear cells in the gall-bladder wall; inflammatory changes were of grades 2 and 3 especially. Adding this group to the list of gall bladders with gross disease gives a total of 463 diseased gall bladders (75.65 per cent of the total necropsy series).

LIPOID CHANGES

Metabolic disturbances in the lipoid mechanism of the gall-bladder wall occur in about 38 per cent of the adult population.

Table III shows that "cholesterosis" occurred alone in 21 per cent of the cases, and papillomatosis alone in 11 per cent. Papillomatous lesions were superimposed on an additional 5.6 per cent of "cholesterosis" cases. And "cholesterosis" occurred in association with gall stones in 2.4 per cent of cases. So that approximately 40 per cent of the necropsy series showed visible lipoid ("cholesterosis") in the gall-bladder wall.

Among 37 gall bladders removed at operation, 13 showed "cholesterosis" alone, 18 in association with gall stones, 4 with papillom-

[1] Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, May, 1925.

TABLE I.—LESIONS OF THE GALL BLADDER FOUND AT NECROPSY

	Age, years															Total	Per cent
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85		
Specimens examined	65	5	16	29	39	48	58	54	74	81	66	43	30	1	5	612	
Grossly normal	62	4	10	10	8	15	19	20	21	28	16	14	7		1	235	38.39
Grossly minor	1		1	3	4	5	9	6	5	3	3	2	1		1	44	7.18
"Cholesterosis"		1	3	7	15	14	15	13	17	13	19	6	7	1		131	21.40
Papillomatosis			1	6	4	8	4	5	12	10	4	5	5		1	65	10.62
Stones			1	3	7	6	9	9	18	23	20	16	9		2	123	20.09
Carcinoma					1		2	1	1	4	4		1			14	2.28
Total abnormal specimens	1	1	6	19	31	33	39	34	53	53	50	29	23	1	4		
Per cent	1.5	20.0	25.0	65.5	79.4	68.7	67.0	62.9	71.6	65.4	75.7	67.4	76.6	100.	80.0		

ata and stones, and two with papillomatosis and stones.

It is evident that "cholesterosis" of the gall bladder is a disease of the adult, the greatest percentage occurring at the age of 35, although a surprisingly high percentage occurs in younger persons (Table III). In one instance it was present in a girl of 13, and in 2 other patients under 20. "Cholesterosis" without any other gross lesion was seen in 131 of 612 adult subjects, 21 per cent.

MacCarty (33), in 1919, reported that 18 per cent of 5,000 surgically removed gall bladders showed this cholesterin deposit, and C. H. Mayo (39), in 1921, reported 39 per cent of 1,254 operative gall bladders with this lesion.

The papillomatous gall bladder is essentially a condition of "cholesterosis," but the picture is somewhat different, in that the cholesterin lipoid is piled up in localized polypoid areas, and for this reason deserves a separate classification. In this series there were 65 instances of papillomatosis of the gall-bladder wall; in six instances diffuse "cholesterosis" was also present, so that 196 patients had gross evidence of disturbed lipoid mechanism alone in the gall-bladder wall, 31 per cent.

TABLE II.—MINOR GROSS LESIONS OF THE GALL BLADDER FOUND AT NECROPSY

	Cases
Adhesions to colon (with fistula 2)	7
Adhesions to duodenum (with fistula 2)	9
Adhesions to other organs (with fistula 4 to abdominal wall)	10
Marked fibrosis alone	22
Diverticula without stones	11
Single non-cholesterin polyp	1
Adenoma	2
Acute congestion	7
Total	69*

*Forty-four (7.73 per cent) occurred independent of other pathologic changes in the gall bladder.

In 1915, C. H. Mayo (38) reported 107 of 2,538, 4.2 per cent, surgically removed gall bladders with this lesion, and MacCarty (33), in 1919, reported 4 per cent of 5,000 surgically removed gall bladders.

TABLE III.—LIPOID CHANGES FOUND IN THE GALL BLADDER AT NECROPSY

Cases examined	Age, years	"Cholesterosis," alone	Papillomatosis	Total	Per cent
63	15				
5	20	1		1	20.0
10	25	3	1	4	25.0
29	30	7	6	13	44.8
39	35	15	4	19	48.7
48	40	14	8	22	45.8
58	45	15	4	19	32.7
54	50	13	5	18	33.3
74	55	17	12	29	39.1
81	60	14	10	24	29.6
66	65	19	4	23	34.8
43	70	6	5	11	25.5
30	75	7	5	12	40.0
1	80	1		1	not counted
5	85		1	1	20.0
612		131 (21.4 per cent)	65 (10.6 per cent)	197	31.3 per cent

TABLE IV.—LIPOID CHANGES

Microscopic lipoid	"Cholesterosis"	Papillomatosis
Grade 1	51	19
Grade 2	43	15
Grade 3	5	7
Grade 4	4	4

The microscopic picture of lipoid as seen in "cholesterosis" of the gall bladder has been fully described by MacCarty and McGrath (34), Corkery (10, 11), Boyd (8), Aschoff (4), Aschoff and Bacmeister (5), Stewart (60), and others. The picture in this series does not differ materially (Table IV), except that early cytolytic changes occur in the postmortem specimen. These changes were fully discussed

previously (44). In 46 of 477 cases in which both Sudan III and Lorrain-Smith's Nile blue sulphate stains were used, lipoid was visible microscopically whereas it was not macroscopically. Boyd (9), in an analysis of 100 gall bladders surgically removed, found 10 with grossly visible fat, and 52 with microscopic lipoid.

It was previously suggested that "cholesterosis" of the gall bladder is but a single and localized instance of metabolic fat disturbance occurring throughout the rest of the body (42, 43). It is a well established fact that pregnancy and obesity are often precursors of disease of the gall bladder. In these two conditions there is a manifest derangement in the fat balance in the body. That "cholesterosis" is the principal gall-bladder disease occurring with obesity and pregnancy has not been suggested by other authors.

Among 110 women who had been pregnant and had gall-bladder disease, 64 per cent showed "cholesterosis" of the gall bladder, and the total percentage of gall-bladder lesions in parturient women is 82. Of 34 patients weighing over 210 pounds and having gall-bladder disease, 70 per cent showed "cholesterosis."

In a study of microscopic fat in the liver, 41 per cent of the livers not associated with "cholesterosis" of the gall bladder revealed lipoid, whereas 48 per cent of those associated with "cholesterosis" of the gall bladder revealed it. This meager difference seems of little significance, but the much severer grade of replacement of fat in the latter group is of considerable moment.

That "cholesterosis" of the gall bladder is essentially a non-inflammatory lesion is fairly well recognized (Table V). Indeed I have produced the microscopic picture of this condition experimentally in the dog in the absence of inflammatory changes (42). Surgeons the world over have noted the very thin wall of the "strawberry" gall bladder; indeed, this wall is often so thin that the cholesterin markings may be seen through the serosa.

Furthermore, the periductal leucocytic infiltration in the liver in cases of "cholesterosis" and papillomatosis is far less than in those of any other gall-bladder lesion, and less, even, than the percentage involvement in the "negative" gall-bladder group, as is shown later.

TABLE V.—INFLAMMATORY CHANGES IN THE WALL OF THE GALL BLADDER

	Grossly negative gall bladder	Grossly visible lipoid in wall of gall bladder				Gall stones
		Per cent	Papilloma-tosis	"Cholesterosis"	Total per cent	
Leucocytes, grade 1 (alone)	29	30.5	17	33	31.9	
Leucocytes, grade 2 (alone)	6	6.3	5	12	10.8	
Lymphocytes, grade 1 (alone)	49	51.5	21	34	35.0	
Lymphocytes, grade 2 (alone)	17	17.9	5	6	7.0	11
Lymphocytes, grade 3 (alone)				1	0.6	11
Lymphocytes and polymorphonuclears, grade 1	8	8.3	5	12	10.8	13
Lymphocytes and polymorphonuclears, grade 2	13	13.6	12	19	19.8	20
Lymphocytes and polymorphonuclears, grade 3 or 4	13	13.6	5	14	12.1	23

This relationship is likewise evident in the comparison tables of inflammatory changes in the appendix, in cases of gall stones and of "cholesterosis."

GALL STONES

Gall stones were found in 123 of the 612 postmortem specimens, 20 per cent.

None, however, was seen in persons under 21 years, thus raising the percentage figure to more than 21 per cent of the adults. Also, there were gall stones in 11 cases of malignant disease involving the gall bladder. Table VI gives the incidence of gall stones as recorded by various authors and in different countries.

In the Copenhagen series from 4.95 to 19 per cent of males were afflicted with gall stones, and from 11.27 to 31 per cent of females. In the Johns Hopkins series of gallstone cases 28 per cent of the patients were males and 72 per cent females. Eusterman (17) reported that 76 per cent of 9,115 gallstone cases were in females. Miyake reported that only 3 per cent of Japanese women have stones. Alvarez, Meyer, Rusk, Taylor, and Easton report that of 60 cases of gall-bladder disease, 33 per cent had stones; 19 were in men and 41 in women. In my series the sexes

were almost equally divided (62 males, 61 females), but the percentage figures for the total number of males and females gave the female proportion a greater incidence of stones, 16.75 per cent males and 28.18 per cent females. The age incidence in cases of gall stones is shown in Tables VII and VIII. The youngest in this series was a man aged 23 years.

Richter has reported the largest stone yet found. It weighed 3 ounces and 5 drams (112 grams). The greatest number of stones so far reported is 7,000, reported by Otto in 1863. Vachel and Stevens have reported the greatest number of actual stones in the biliary ducts, 520 stones in the hepatic ducts, weighing 1,378 grams. The incidence of the different types of stones in my series is shown in Table IX.

Table X shows the incidence of "white bile" as reported by various authors.

In the group of single cholesterin stones, and in the group of cholesterin-rich stones, with an indefinite history of gastric distress, the inflammatory stigmas in the gall-bladder wall were not so marked as in the group of common stones. Indeed, in several instances of cholesterin stones, the gall-bladder wall was extremely thin, and often showed little microscopic evidence of inflammatory change. Especially was this true in the cases with pure cholesterin stones, or cholesterin-rich stones

TABLE VI.—INCIDENCE OF CASES OF GALL STONES

Author and locality	Cases examined	Per cent	Found at
Mitchell, Norway		2.0	Necropsy
Mitchell, Chicago	1,600	3.1	Necropsy
Mayo, W. J.	Men	4.0	
	Women	8.0	
Peters, Kiel		5.0	Necropsy
Rother, Munich		6.0	Necropsy
Fielder, Dresden		7.0	Necropsy
Mayo, C. H., Mayo Clinic	1232	7.1	Pelvic operation
Schoth, Erlangen		7.2	Necropsy
Mitchell, Munich and Erlangen	19,974	7.8	Necropsy
Mosher, Johns Hopkins		7.85	Necropsy
Bavaria		7+	Necropsy
Alvarez, California		5 to 12	Necropsy
Singer, Germany		10.0	Necropsy
Mitchell, Basel	16,025	10.7	Necropsy
Peterson	542	11.8	Laparotomy
Rovsing, Copenhagen	7,447	8 to 25	Necropsy
Roth, Basel		10.9	Necropsy
Franks, Vienna		10.0	Necropsy
Schroeder, Strassburg		12.0	Necropsy
Mitchell, Sweden		6.6	Necropsy
Naunyn, Germany	Men	4.4	Necropsy
	Women	20.6	
Hektoen and Riesman		About 25	Necropsy
Mentzer, Mayo Clinic, 1924	623 Men	16.7	Necropsy
	Women	28.1	

TABLE VII.—INCIDENCE OF CASES OF GALL STONES BY HEMIDECADES

Age, years	25	30	35	40	45	50	55
Cases with stones	1	3	7	6	10	9	19
Total cases	19	30	41	48	59	59	78
Percentage of total necropsy series	5.2	10.0	17.0	12.5	16.8	16.6	24.3

Age, years	60	65	70	75	80	85
Cases with stones	23	22	13	8		2
Total cases	83	66	46	29	1	5
Percentage of total necropsy series	27.7	33.3	28.2	27.5		40.0

TABLE VIII.—GALL STONES IN THE YOUNG

Author	Cases	Per cent	Age
Kellogg	1		Eight months' fetus
Khantz	5		Newborn
Paulsen	1		Six months
Singer	5		Under ten years
Kellogg	1 (52 stones)		Girl aged eleven years
Kellogg	44		Under fifteen years
Keyes		0.75	Under twenty years
Harley		1.00	Under twenty years
Blalock		1.50	Under twenty years
Mayo Clinic			Youngest, aged twenty-three years

TABLE IX.—GALL STONES

	Cases
Found at operation	45
Removed elsewhere	9
Removed in Mayo Clinic	28
Re-operated in Mayo Clinic	8
Found at necropsy	88
Single cholesterin stones	8
Multiple cholesterin stones	10
Single common stones	8
Multiple common stones	55
Bilirubin-calcium stones	7
Total (21.6 per cent)	123

"Sand" was found in 3 cases and "inspissated bile" in 26 cases.

TABLE X.—WHITE BILE (KAUSCH)

Author	Operation	Cases	White bile	
			Cases	Per cent
Klose	Gall bladder	638	5	0.79
Judd	Common or hepatic ducts	649	19	2.9
Blalock	For gall stones	460	41	9.0
Mayo Clinic, 1924	For gall stones	123	9	7.2

	Largest amount, liters
Tait	5
Terrier	20
Erdmann	28

(mulberry stones, gooseberry stones, jack stones, or cholesterin-rich common stones), in which there was an evident history of intermittent hypercholesterolæmia, particularly in association with pregnancy. Here the clinical and pathological pictures strongly suggest the metabolic origin of gall stones, for inflammatory stigmas are often meager. In 36 of 41 cases, 87 per cent, of cholesterin-rich stones, the leucocytic and lymphocytic involvement of the gall-bladder wall was graded below 2, whereas in an equal number of cases of dark common stones 29, 71 per cent, were graded above 3.

In the group of cases with cholesterin-rich stones, the gall-bladder wall almost universally contained a high degree of microscopic lipoid, whereas in the majority of the cases of common stone, especially dark stones and bilirubin-calcium stones, there was no microscopic fat in the mucosa or stroma.

CARCINOMA OF THE GALL BLADDER

Carcinoma involving the gall bladder was found in 14 cases, 2.28 per cent. Three were primarily pancreatic, 10 were very probably primary in the gall bladder, and 1 was indeterminate. Of the 10, 3 were carcinoma simplex and seven adenocarcinoma. Thus, in 1.63 per cent of the entire series, the carcinoma was primary in the gall bladder. Table XI gives the percentage of carcinoma of the gall bladder found in various series of gall-bladder cases.

The age incidence in cases of carcinoma of the gall bladder is rather high. In my series, the greatest number of cases was found at the age of 60; the youngest was 33 and the oldest 72. The youngest case reported is that of Maxon in a boy of 4; Erdmann reports a case in a boy of 15.

The occurrence of gall stones with biliary malignant disease is very variable, as recorded in the literature, from 100 (Janowski) to 69 per cent (Musser). In all of my 14 cases of malignant disease of the gall bladder, gall stones were associated. In 10 definite cases of primary carcinoma of the gall bladder, 6 were in males and 4 in females.

Sarcoma of the gall bladder is not so common, only 18 cases having been recorded to date. In this series only 1 case of primary sarcoma of the gall bladder was found.

HISTORY AND SYMPTOMS

A positive history indicating gall stones was obtained in only 50 per cent of the cases with gall stones, for among 123 cases of gall stones, only 61 afforded a positive history of gall-stone colic; in 58 of these operation had been performed. A suggestive history of disease of the gall bladder was obtained in 5 others, 2 per cent. But a very positive history of colic and the usual syndrome of flatulence, belching, and qualitative food distress, was obtained in 2 cases, in which "cholesterosis" alone, was found. Negative histories were obtained in a relatively high percentage of cases (Table XII).

TABLE XI.—CARCINOMA OF THE GALL BLADDER

Author and place	Cases	Per cent	Found at
Fawcett and Rippman	592	12.0	Necropsy
Erdmann	228	8.0	Operation
At Goettingen		7.0	Necropsy
Erdmann, later data		6.7	Operation
Kaufmann		5 to 6	Necropsy
At Basel		5.2	Necropsy
At Breslau		5.0	Necropsy
Mayo, W. J.	3,908	4.6	Operation
Blalock	888	4.9	Operation
Smithies	1,000	3.1	Operation
Deaver	1,000	1.6	Operation
Deaver	1,128	1.07	Operation
Magoun and Renshaw	7,878	1.04	Operation
Mentzer, Mayo Clinic, 1924	633	1.63	Necropsy

It has been said that "silent" gall stones are a myth. This is, indeed, probably quite true, but these data show how difficult it is to obtain a reliable history.

TABLE XII.—NEGATIVE GASTRIC HISTORY IN CASES OF DISEASE OF THE GALL BLADDER

	Cases	Per cent
"Cholesterosis"	114	87.0
Papillomatous gall bladders	14	20.0
Gross lesions of gall bladder	16	36.0
Gall stones	11	0.8

Careful gastric histories were "negative" in 43 cases of disease of the gall bladder.

Suggestive gastric disease in 22 cases in which no gall bladder, appendiceal, gastric, or duodenal disease was found at necropsy.

RELATION OF TYPHOID FEVER TO DISEASE OF THE GALL BLADDER

The early pathologists were the first to note the relation of typhoid fever to gall-

bladder disease. Their observations have been repeatedly verified (Table XIII). Recently

TABLE XIII.—INCIDENCE OF TYPHOID FEVER WITH DISEASE OF THE GALL BLADDER
(633 Necropsies)

	Cases	Per cent
Negative findings in gall bladder	20	8.5
Disease of the gall bladder	88	23.3
Gall stones	51	
"Cholesterosis"	25	
Minor grossly visible lesions	12	

Blalock found that typhoid had been a precursor in 28 per cent of gall-bladder cases. Alvarez obtained a history of typhoid in only 7 of 60 cases of gall-bladder disease, and Reid and Montgomery have collected but 28 cases of acute cholecystitis complicating typhoid fever.

In this series the females with gall-bladder disease do not predominate in the usual proportion, for 57 per cent of the total males had gall-bladder disease and 64 per cent of the total females (Table XIV).

TABLE XIV.—SEX INCIDENCE IN CASES OF DISEASE OF THE GALL BLADDER

	Males	Per cent of total	Females	Per cent of total
Gross gall-bladder lesions (including carcinoma)	33	6.5	23	7.26
"Cholesterosis"	87	33.7	44	28.6
Papillomatosis	41		20	
Stones	62	16.75	61	28.1
Total	223	56.9	148	63.96

The cases of gall stones are almost equally divided between the sexes, but the proportion of males and females so afflicted is quite different. On the other hand, the proportion of "cholesterosis" and papillomatosis of the gall-bladder wall is greater in the male than in the female.

RELATION OF PREGNANCY TO DISEASE OF THE GALL BLADDER

Huchard, in 1882, was the first to note the relation of gall-bladder disease to pregnancy. Since that time many observations have been made verifying his opinion. At present the literature emphasizes the association of hypercholesterinæmia and gall-bladder disease with pregnancy. Osler stated that 90 per cent of women who had gall stones had borne children, and this observation has been repeatedly verified to a greater or less degree. In this series of 134 women with gall-bladder disease, 110 had been pregnant one or more times, 82

TABLE XV.—NUMBER OF PREGNANCIES AND THE TYPE OF ASSOCIATED DISEASE OF THE GALL BLADDER

	No pregnancies	Per cent of total	Para 1	Para 3	Para 5 or multipara	Per cent of total
Gross gall-bladder lesions (including carcinoma)	4	18.1	5	5	8	81.9
"Cholesterosis"	8	19.5	6	11	16	80.5
Papillomatosis	4	23.5	3	4	6	76.5
Stones	8	13.7	6	18	22	86.3
Total	24		110 (82.09 per cent)			

per cent (Table XV). Alvarez, however, found that of 41 women with gall-bladder disease, 17 had had no children, 41 per cent.

RELATION OF OBESITY TO DISEASE OF THE GALL BLADDER

That obesity has likewise been associated with gall-bladder disease has long been observed. In this series 44 of the patients weighed more than 210 pounds; 34 of these, 77 per cent, had some lesion of the gall bladder (39 per cent with stones, 38 per cent with "cholesterosis"), and 10 had no lesion of the gall bladder. From Table XVI it is evident

TABLE XVI.—RELATION OF OBESITY TO INCIDENCE OF DISEASE OF THE GALL BLADDER

	Weight, pounds											
	Below 100	120	140	160	180	200	220	240	260	280	300	602
Gross lesions	7	14	14	7	8	4						
"Cholesterosis"	12	16	39	39	14	12	1				1	
Papillomatosis	5	6	17	8	13	5	4	1		1		1
Stones	1	17	30	31	19	14	1	2	2		1	
Total	25	53	100	85	54	35	6	3	2	1	2	1
Cases both with and without disease of the gall bladder	107	89	163	122	76	44	13	4	2	1	2	1
Percentage with disease of the gall bladder	22.9	59.5	61.3	69.6	71	79.5	46.1	75	100	100	100	100

that the proportion of diseased gall bladders increases with increase in body weight.

TABLE XVII.—DISEASE OF THE GALL BLADDER WITH ASSOCIATED APPENDICEAL DISEASE OR PEPTIC ULCER*

	Gross lesions	"Cholesterosis"	Papillomatosis	Stones	Carcinoma	Total
Appendiceal lesions alone	23	63	22	51	4	163
Appendiceal lesions with peptic ulcer	14	32	11	18	4	79
Peptic ulcer alone	3	21	4	5		33
Multiple peptic ulcers	4	32	12	18	3	11

*79.6 per cent of gall-bladder cases had associated appendiceal or ulcer lesions.

ASSOCIATION OF INFLAMMATION OF THE GALL BLADDER WITH DISEASE OF OTHER ORGANS

Inflammatory lesions of the abdomen, associated with gall-bladder disease, have been noted frequently. The appendix, stomach, duodenum, liver, and pancreas are most commonly concerned. The association of these organs in inflammatory disease is not surprising, for anatomists have long taught the intimacy of the lymphatic bed in the upper abdomen.

Appendix. It is not known whether the direct connection between the appendix and the gall bladder is by the blood stream or the lymph channels, but it is evident that the appendix is infected in most cases of gall-bladder disease.

Deaver (13) estimated that in 90 per cent of his gall-bladder cases there were associated appendiceal lesions; Blalock found definite evidence of inflammatory changes in the appendix in 129 of 888 gall-bladder cases, 14.5 per cent. Moore (48) has estimated that there were appendiceal lesions in from 30 to 40 per cent of his gall-bladder cases; MacCarty and McGrath (35) reported that in 52 per cent of 57 cases of cholecystitis and in 44.8 per cent of 118 cases of gall stones, the appendix was partially or wholly obliterated, whereas in 2,549 consecutive necropsy cases only 17 per cent showed partial or complete obliteration.

In the 588 cases in my series in which the appendix was examined it was grossly diseased in 351 instances, 60 per cent; there were either dense adhesions, or partial or complete obliteration of the lumen. In the 377 cases of grossly diseased gall bladder in which the appendix was described in 359, the appendix was diseased in 245, 68 per cent. There were therefore 106 appendiceal lesions with no accompanying gall-bladder disease, 45 per cent; but with 68 per cent of the diseased gall bladders there were accompanying appendiceal lesions.

Gastric and duodenal ulcers. Gastric or duodenal ulcers were found in 142 cases, 24 per cent, of the total postmortem series, but they were associated in 105 of 359 cases, 29 per cent, with disease of the gall bladder. In 20 cases more than one ulcer was found.

Eusterman (16) reported that in 13 per cent of 1,000 cases of peptic ulcer, gall-bladder disease was associated. A summary of the appendiceal lesions and peptic ulcers in this series with associated disease of the gall bladder appears in Table XVII.

The significant feature of the data lies in the proportion of cases of appendiceal disease and peptic ulcer, in which there is no associated gross gall-bladder disease. In this series, 12 per cent of the gastric and duodenal ulcers were not accompanied by demonstrable lesions in the gall bladder or appendix, whereas 27 per cent of the appendiceal lesions were unaccompanied by gall-bladder disease or peptic ulcer, and 20 per cent of the gall-bladder cases showed no associated appendiceal disease or peptic ulcer (Tables XVIII, XIX, XX, and XXI).

TABLE XVIII.—INCIDENCE AND TYPE OF APPENDICEAL AND ASSOCIATED LESIONS OF THE GALL BLADDER

Appendix	Gall bladder					
	Gross lesions	"Cholesterosis"	Papillomatosis	Stones	Carcinoma	Total
Surgically removed	8	20	5	23	1	57
Examined at necropsy						
Adherent	8	24	7	4	1	44
Obliterated	2	10	1	7	1	21
Both obliterated and adherent	5	12	9	17	1	44
Peptic ulcers associated	14	32	11	18	4	79
Total	37	98	33	69	8	245
No record	3	5	1	14	1	24
Percentage of lesions of the gall bladder	56.06	77.7	47.1	63.3	61.5	67.96

TABLE XIX.— APPENDICEAL DISEASE IN ASSOCIATION WITH DISEASE OF THE GALL BLADDER OR PEPTIC ULCER*

	With lesions of the gall bladder alone	With ulcer	With neither	With both
Adherent appendix	42	7	28	15
Obliterated	34	5	17	7
Both adherent and obliterated	34	5	21	14
Surgically removed	53	16	29	25
Total	163	33	95	61
Per cent	46.3	9.37	26.9	17.37

*73 per cent of appendiceal cases had associated gall bladder or ulcer disease.

Liver. It has long been known that inflammatory changes occur in the liver in a high percentage of cases when there is disease of the gall bladder.

Riedel, in 1888, first described the tongue-like projection of the liver in cases of hepatitis, and Naunyn, in 1892, noted the general enlargement of the liver in gall-bladder disease. Langenbach, Fink, and Mayo Robson soon corroborated their observations. Grube and Graff have described hepatitis almost invariably with gall-bladder disease;

TABLE XX.— PEPTIC ULCER IN ASSOCIATION WITH LESIONS OF THE GALL BLADDER OR APPENDIX*

	With lesions of the gall bladder	With appendiceal lesion	With neither	With both
Gastric	16	11	8	19
Duodenal	28	22	11	42
Total	44	33	19	61
Per cent	27.8	20.8	12.02	39.0

*In 88 per cent of ulcer cases there was associated disease of the gall bladder or appendix.

TABLE XXI.— INCIDENCE OF PEPTIC ULCER AND LESIONS OF THE APPENDIX WITH DISEASE OF THE GALL BLADDER

	Cases	Per cent
Associated lesions of the appendix	163	46.30
Associated peptic ulcers	44	11.68
Associated lesions of the appendix and gastric ulcer	79	22.00
Total associated lesions	286	79.64

Peterman, Priest, and Graham state that in 1917 in 87 per cent of their 30 operative gall-bladder cases there was enlargement of the liver. Kehr (27, 28, 29) found hepatic enlargement in only 15 to 20 per cent of his cases of cholecystitis. MacCarty (32) found hepatitis in 81 per cent of the cases of cholecystitis, and Weible in 60 per cent of 46 cases of cholecystitis. Most of the observers have taken sections of the liver adjacent to the operative site, namely, the edge of the liver, close to the site of the gall bladder. Tietze and Winkler, however, in 50 cases of cholelithiasis found evidence of inflammatory changes in the liver in almost every case, even in sections taken from the dome of the right lobe of the liver, opposite the gall bladder.

In my studies, sections were taken from at least three localities in the liver: adjacent to the gall bladder, from the dome of the right lobe of the liver, and from the dome of the left lobe of the liver. It is evident, at once, that there is a marked variation in the microscopic picture, dependent on the site of excision of the specimen. As a rule, in this series, the liver almost always showed varying degrees of hepatitis in the sections from tissue adjacent to the gall bladder, whereas many of the sections from the dome of the left lobe of the liver, even in cases of severe cholecystitis with cholelithiasis, showed no comparable evidence of inflammatory change.

Among 548 postmortem cases with full records and a careful gross description of the liver, microscopic sections were made in all but 62 cases. The microscopic findings are given in Table XXII.

It will be seen from Table XXII that the liver was involved in inflammatory lesions in

TABLE XXII.— INCIDENCE OF HEPATIC DISEASE ASSOCIATED WITH DISEASE OF THE GALL BLADDER

	Lymphocytes and polymorphonuclear cells				
	Total	Periportal	Per cent	Periductal	Per cent
Without lesions of the gall bladder	142	40	28.1	64	45.07
With gross lesions of the gall bladder (including carcinoma)	51	9	17.6	23	45.09
With "cholesterosis" of the gall bladder	129	27	20.9	51	39.5
With papillomatosis of the gall bladder	55	11	20.0	26	47.2
With stones in the gall bladder	109	35	32.1	71	65.1

a greater percentage of cases with gall-bladder disease than without. Also it is evident that the "cholesterosis" group shows a considerably less degree of associated liver lesions than the more evidently inflammatory group, of stones, or gross lesions of the gall bladder, for instance. The latter is especially high because it includes the carcinomata.

The percentage involvement of the liver in cases of gall stones is obviously higher than in the other groups. The "minor gross lesion" group varies but little from the "negative" group in the periductal areas. This, of course, is not surprising, for as will be recalled, the "minor gross lesion" group includes those lesions that are not inflammatory: diverticula (congenital), adenomata, single polyps, and so forth. It must be borne in mind, too, that this group has a very low percentage of hepatic involvement, for in this table are included only those cases in which both polymorphonuclear cells and lymphocytes are present, that is, positive evidence of inflammatory changes.

TABLE XXIII. — TOTAL INCIDENCE OF INFLAMMATORY CHANGES IN LIVER IN ASSOCIATION WITH DISEASE OF THE GALL BLADDER

	Periductal lymphocytes, grade 2 to 4	Per cent	Per cent of total cases
Without lesions of the gall bladder	39	29.4	72.47
With gross lesions of the gall bladder	8	15.6	60.69
With "cholesterosis"	27	20.9	60.4
With papillomatosis	20	36.3	83.5
With gall stones	35	32.1	97.2

If those instances of periductal lymphocytic infiltration, graded as 2, 3, or 4, are added, the proportion of hepatic involvement would increase markedly. From the pathologist's point of view, at least, this group should be included, and since pathologists have determined the presence of hepatitis by this means, it may well be included in the total list of cases with associated hepatic involvement (Table XXIII).

It is evident from Table XXIII that from 60 to 70 per cent of all livers show evidence of pathological changes at postmortem examination, regardless of the presence or absence of gall-bladder disease. The cases of non-inflammatory disease of the gall bladder (minor gross lesions, such as adenomata, diverticula, adhesions to adjacent organs, without other evidence of disease of the gall bladder), and "cholesterosis" show a relatively small percentage of associated hepatic disease, 60 per cent, as compared with the definitely inflammatory diseases, such as gall stones, 97 per cent.

Pancreas. Inflammatory changes in the pancreas are relatively rare in association with gall-bladder disease. Foci of lymphocytes, and especially leucocytes, in the stroma and about the pancreatic ducts were noticeably absent on microscopic examination, even in the cases of cholelithiasis.

Fallon states that postmortem examinations of the pancreas show lesions of greater or less degree in 50 per cent of the cases. Blalock found 36 of 735 gall-bladder cases, in which the pancreas was definitely indurated. The many theories of pancreatitis (those of Deaver, 12, Eggers, Flexner, Archibald, and Mann and Giordano) all admit the frequency of gall-bladder disease with pancreatitis, but the percentage varies greatly. W. J. Mayo has stated that 86 per cent of the cases of pancreatic disease are associated with gall stones, and that 7 per cent of the gall-stone cases are associated with pancreatitis. Moore (49) estimates that cholecystitis is associated with from 50 to 80 per cent of the cases of pancreatic disease. Barling says that pancreatitis occurs in from 25 to 30 per cent of gall-stone cases. Nicoll, in 1919, reported that he had operated on 7 patients for gall-bladder disease, duodenal, or gastric ulcer, and in each case found only pancreatitis.

In 1921, Judd stated that pancreatic lesions were relatively rare with gall-bladder disease, although in a series of 1,290 cases of disease of the gall bladder or ducts, he found associated pancreatitis in 26.8 per cent. Pancreatitis, as suggested by the hard "corn-cob" feel, was found in 14 of 47 gall-bladder cases, in 21 of which there were gall stones.

Alvarez and his coworkers, likewise, state that pancreatitis is relatively rare with gall-bladder disease, and my series bears out this

statement. In a total of 501 necropsy cases in which the pancreas was examined microscopically, polymorphonuclear cells were found in the stroma in only 35 (Table XXIV). These percentages are in marked contrast to those of hepatic involvement. Sections were taken from the head, body, and tail of the pancreas, and the figures give the average of these three areas. Sections from the head of the pancreas show a slightly greater frequency and degree of involvement than those from the body and tail, but the difference is not marked. The normal variation in the amount of connective-tissue stroma is probably rather great, and in this series it seems justifiable to state that connective tissue was increased in only 15 cases; in 11 of these there were gall stones.

TABLE XXIV.— INFLAMMATORY CHANGES IN THE PANCREAS IN ASSOCIATION WITH DISEASE OF THE GALL BLADDER*

	Lymphocytes only						Leucocytes and lymphocytes					
	Grade				Total	Per cent	Grade				Total	Per cent
	1	2	3	4			1	2	3	4		
Pancreatic lesions without lesions of the gall bladder	3	2	2	1	8	1.4	14	12	10	3	39	7.7
With gross lesions of the gall bladder	1	1	1		3	0.59	4	3	4	1	12	2.3
With "cholesterosis"	3	2	1		6	1.18	18	7	3		28	5.5
With papillomatosis	3	3	1		7	1.38	5	3	6	1	15	2.9
With stones	5	3	2	1	11	2.1	0	9	10	5	30	5.9

*The second column of lymphocytes and polymorphonuclear cells gives the total percentage of inflammatory changes in the pancreas, for in no instance were polymorphonuclear cells found without lymphocytes.

It is surprising that in 7.7 per cent of the necropsies in which no gall-bladder lesion was found there were definite inflammatory changes in the pancreas, whereas in only 5 per cent of the necropsies in which disease of the gall bladder was found were there like pathological changes in the pancreas. Probably the high incidence of abdominal carcinomatosis in this series would account for the large number of cases of inflammation of the pancreas.

SUMMARY

Sixty-six per cent of 612 consecutive necropsy cases at the Mayo Clinic showed grossly visible pathological changes in the gall bladder. Seventy-five per cent of the gall bladders showed microscopic pathological changes. Seven and seven-tenths per cent of the deaths were due to disease of the gall bladder, *per se*. Gall-bladder disease is essentially a disease of adults. The youngest patient was a girl aged 13 years.

Eight per cent of the diseased gall bladders showed only minor inflammatory changes. "Cholesterosis" of the gall bladder is essentially a non-inflammatory disease. It was present in 38 per cent of the total series. Eighty-two per cent of women who had been pregnant had some grossly visible gall-bladder disease. Sixty-four per cent of them showed "cholesterosis" only. In 70 per cent of the patients weighing more than 210 pounds, this lipoid disturbance was grossly visible in the gall-bladder wall. Gall stones were found in 22 per cent of the adults; 17 per cent of the males had stones, whereas 28 per cent of the females had them. The youngest case occurred in a woman aged 23. Hydrops of the gall bladder was found in 7 per cent of the series. The inflammatory changes in the gall-bladder wall, and in neighboring organs, were less in the cases of stones rich in cholesterin than in the pigmented stones (common stones). Primary carcinoma of the gall bladder was found in 1.63 per cent of the total series. There was one case of primary sarcoma of the gall bladder. Gall stones were found in all the cases of malignant disease involving the gall bladder.

"Negative" histories in gall-bladder disease are of little value. In 8.5 per cent of the total necropsy series there had been a history of typhoid fever, whereas in 23 per cent of the gall-bladder cases there had been a positive typhoid history.

Sixty-eight per cent of the diseased gall bladders were accompanied by disease in the appendix. Gastric or duodenal ulcers were found in 29 per cent of the cases of diseased gall bladder. In 80 per cent of the cases of diseased gall bladder there was associated disease in the appendix, stomach, or duodenum. Inflammatory changes in the liver are more frequent in cases of inflammatory disease in the gall bladder (stones) than in

cases of non-inflammatory disease ("cholesterosis"). Inflammatory changes in the pancreas are relatively infrequent in gall-bladder disease.

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PROLIFERATIVE GINGIVITIS OF PREGNANCY[1]

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DISTURBANCES in the mouth during pregnancy have been divided by Kieffer (8) into three classes, neuralgias, gingivo-stomatitides, and rapidly progressing caries. Rosenstein (15) added a fourth class, namely, new-growth formation. Poletti (13) increased the list further with hyperactivity of the salivary glands, paræsthesias of the mucosa, alterations of taste, and exacerbations of diseased processes in soft tissues, periosteum, and bone. I shall not in this paper discuss all the above changes, but shall limit my discussion to the effect of pregnancy upon the gingival tissues.

The epulis or giant cell tumor is one of the commonest growths found upon the gums. The term is also used loosely to include fibromata of the gums. Numerous writers have observed that the growth of an epulis appears to be accelerated by pregnancy. Thus Gunzert (4) described 5 cases. In one there took place during the first pregnancy a recurrence of a growth which had been excised 3 years before. It was again removed, but recurred once more 2½ years later, during the sixth month of the second pregnancy. In his second case, an epulis began in the sixth month. His third patient had had one for a year. It had remained quiescent until the first month of the sixth pregnancy, when it began to grow rapidly. His fifth case showed a rapidly increasing epulis in the early part of the third pregnancy. Four of the five growths on microscopical examination proved to be giant cell sarcomata, the other growth, a fibroma.

Perthes (12) reported the following case. The patient, 25 years of age, had had for 5 years a pea-sized growth on the gum of the upper jaw, exactly in the median line. About 3 months after she had become pregnant for the first time, she noticed that the growth was increasing in size. When he saw her 2 months later, it was as large as a hazelnut. During her sixth month, it was removed and its base cauterized. Microscopical examination showed it to be a giant cell tumor. Two weeks after its removal it recurred and at the birth of her child some 3 months later was so large that speech and closure of her mouth was rendered difficult. Three months after delivery, it had shrunk spontaneously to the size of a lentil.

Hesse (5) reported 8 cases of growths in pregnant women. In 5, the growth began in pregnancy. In 2, there was a rapid increase of a growth already present and, in 1, a recurrence during pregnancy. Their histological structure is not given by Rosenstein, from whom the cases are cited.

Rosenstein (15) reported 2 cases first seen after confinement. The patients stated that the growths had begun during pregnancy and did not regress after delivery. In a third case, the growth had begun to form several months before the advent of pregnancy and had increased in size during that condition. All three had been excised, but their histological structure was not reported.

No doubt, some of the growths described by Hesse and Rosenstein belonged to the giant cell tumor type. At any rate, the above cases would tend to indicate that Gunzert (4) was right in stating that pregnancy is not the initiating factor in the production of an epulis, but tends to accelerate the growth of one already present or one which has not been fully removed. The cases cited do not justify Rosenstein in ascribing to pregnancy the power of new-growth formation.

It has also been known for a long time that pregnancy is associated with the production of inflammatory changes in the gingival tissues. Biro and Arkovy (1) have described a diffuse gingivitis of pregnancy in which the color of the gum is scarlet red and not grayish white or dark red as in catarrhal gingivitis and the gum edges are especially reddened and swollen.

Kieffer (8) described as follows the gingivitis of pregnancy: "The gums are dark red

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in color, bleeding upon the slightest touch and stand away from the teeth; the changes are most marked in the incisor and cuspid region, least in the molar region. The process may extend so far as to cause loosening and loss of the teeth and is generally seen at the beginning of pregnancy."

Musgrave (11) described a gingivitis of pregnancy, stating that the gums are swollen and tender and bleed at the slightest touch.

Coles (3), on the other hand, stated that he had failed to find any condition of the gums that could be regarded as especially and alone connected with pregnancy. He then proceeded to describe two types of gingivitis, in one of which the gums were hyperæmic and in the other, anæmic, thin and shrivelled in their appearance. He came to the conclusion that if any condition of the gums could be said to be especially associated with pregnancy, it was the latter.

It has been observed that in some cases, the gingivitis present during pregnancy acquires a proliferative or productive character, with spontaneous regression after delivery. Mehliss (9) described one such case. Karner (7) observed in one of his patients reddening and marked swelling of the gingiva with regression to normal after delivery and recurrent proliferation with each subsequent pregnancy. Riebe (14) reported the case of a woman, 36 years of age, who had come under observation during her fifth pregnancy. In each pregnancy a growth had begun to form at about the second month. It had been removed several times, only to recur. After each delivery, it disappeared spontaneously. Hesse (5) observed in 2 patients an increase in the size of hypertrophic gums, which had been present before pregnancy.

Zentler (16) reported the case of an anæmic woman, 25 years of age, who, during her first pregnancy, showed rapidly progressing caries of the molar teeth and purplish and sensitive gums. During the fourth month of her second pregnancy, her gums began to hypertrophy, presenting tumefactions here and there. After the birth of her child, the tumefactions disappeared and the gums regained their normal appearance. Zentler laid considerable emphasis upon the fact that the woman was anæmic and attributed the above changes in large part to that fact.

In addition to the cases already mentioned, Rosenstein (15) described the case of a woman, who had noticed the beginning of a growth between the lower incisors in the fifth month of her pregnancy. It increased in size during that period and was removed immediately after childbirth. He called the growth a papillary fibro-epithelioma, but his description of its histological structure places it in the class of chronic inflammatory growths, as there is thickening and proliferation of the epithelium, which in no way resembles carcinomatous tissue, and infiltration of the epithelium with leucocytes and of the submucosa with small round cells.

Brophy (2) stated that in pregnant women it was not an uncommon error to operate upon a hypertrophy of the gums which had been mistaken for epulis, and that after delivery such hypertrophy usually subsided quickly without treatment. Moorhead and Dewey (10) also mentioned hypertrophy of the gums as being observed in pregnancy, occurring toward the middle of the term and lasting until after parturition and even for some time in lactation.

It is thus apparent that the presence of tumor-like masses upon the gums of women during pregnancy, with spontaneous regression after delivery, is not an uncommon occurrence. During the past 3 years, I have observed 6 cases, which I shall now describe in some detail.

CASE 1. A. D., an American negress, was first seen in October, 1922, at the age of 18 years, during the sixth month of her first pregnancy. At the beginning of the second month, she had noticed that the gum between the upper right cuspid and first bicuspid was beginning to increase in size. It grew gradually downward over the buccal aspect of the above teeth. Soon thereafter, the gum tissue on the lingual side between the same teeth began to proliferate. During the fourth month, the gum between the upper left first and second molars extended up the palate for a short distance and also down over the palatal aspects.

The patient was a well developed and well nourished woman, whose physical examination was essentially negative, except for the mouth condition and the accompanying pregnancy. Looking into her mouth, one was immediately impressed by the fact that the above mentioned growths were not isolated

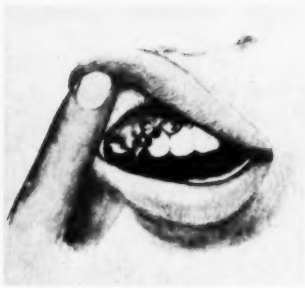

Fig. 1. Case 1. Labial aspect of upper gums.

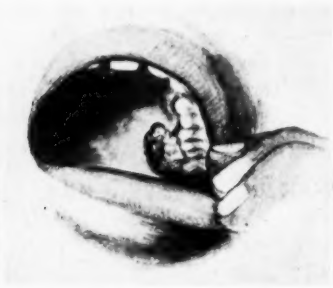

Fig. 2. Case 1. Palatal aspect of upper gums.

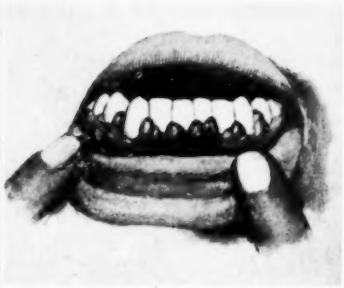

Fig. 3. Case 1. Labial aspect of lower gums.

processes, but were part of a generalized gingivitis and proliferation of gum tissue. The gingival margins of nearly all the teeth were hyperæmic and swollen. In both directions from the two principal growths, smaller growths were seen arising from the interdental spaces. The teeth were in good condition except for deposits of calculus about the necks. (Figs. 1, 2, and 3.)

BUCCAL AND LABIAL SURFACES

1. *Upper right.* In the interspaces between the first and second molars and between the cuspid and lateral incisor, the gum is slightly inflamed, with two red streaks of dilated blood vessels running through it mesially and distally. Between the first molar and the second bicuspid and between the lateral and central incisors, the gum is slightly hypertrophied and purplish, with no red streaks. Between the first and second bicuspid the gum is slightly purplish in color and it is greatly hypertrophied.

The first bicuspid and cuspid are separated from one another by a space of 2 millimeters. In the interspace at the gingiva is a reddish ball of œdematous tissue, 1 millimeter in diameter. Passing distally there is observed a proliferation of gum tissue in the form of three lobulations, each containing a red streak of a dilated blood vessel in the center. Passing mesially from the interspace, the gum shows considerable proliferation, extending down to the biting surfaces of the cuspid and bicuspid and upward about 3 millimeters beyond the gingival edge. It is about 1.5 centimeters in diameter and has a cauliflower-like appearance. It is composed at its periphery of small lobulations, each connected by a stalk with larger lobules, which combine to form one mass attached by a pedicle to the gum at the neck of the cuspid tooth. The body of the growth is purplish red in color, but directly on the biting surface are observed some yellowish necrotic lobules, evidently due to the trauma of mastication. There is a bridge of tissue connecting the above growth with one on the palatal side between the same teeth. It is of similar character, but much smaller.

2. *Upper left side.* Between the upper right central incisor and left lateral incisor (left central unerupted) and between the lateral and cuspid, the gum is slightly inflamed, with two red streaks of dilated blood vessels running through it.

Between the cuspid and first bicuspid, the gum is beginning to show proliferation and marked inflammatory changes. Mesially several hyperæmic streaks are present. At the embrasure gingivally, there is a distinct growth, 2 millimeters in diameter, under which an instrument can be insinuated. There are several hyperæmic streaks running through it. By a narrow strand of tissue it is connected through the interspace with a similar growth on the palatal aspect.

Between the first and second bicuspids, between the second bicuspid and first molar, and between the first and second molars, are small growths, 2 millimeters in diameter, similar to the growth described as being between the cuspid and first bicuspid except that these growths do not extend palatally.

3. *Lower teeth.* Behind the first bicuspid on both right and left sides the gum is normal. Anterior to the above teeth, there is gradually increasing hyperæmia and lobulation, until anterior to the cuspid region on both sides, a real but small growth of tissue springs from each interspace.

LINGUAL SURFACE

4. *Upper left.* Between the second and first molars and between the upper right cuspid and first bicuspid, a large growth is present, 1.6 centimeters in diameter, similar in all respects to that described under the buccal surface between the upper right first bicuspid and cuspid.

Between the first molar and second bicuspid and between the second bicuspid and first bicuspid the gum is swollen with hyperæmic edge.

Between the first bicuspid and cuspid is the same condition as that found in the upper left buccal surface between the cuspid and first bicuspid.

Between the cuspid and lateral incisor and the lateral incisor and right central incisor the gum is normal.

5. *Upper right.* Between the central and lateral incisors the gum is normal. Between the lateral incisor and cuspid, is slight hyperæmia. The gum between the remaining teeth is normal.

6. *Lower teeth.* The gum between all the lower teeth shows beginning hyperæmia and lobulation to a slight extent.

The blood Wassermann reaction and urine tests were negative.

In October, 1922, in the sixth month of pregnancy, the growth in the right cuspid region was excised. At the same time the smaller ones between the three teeth behind the cuspid were also excised to determine if possible the method of growth and any differences between them. At the operation, it was observed that the larger growth was attached by a pedicle to the upper portion of the peridental membrane of the cuspid tooth. The base of the growths was cauterized with silver nitrate. No teeth were removed.

Microscopically, no difference could be observed between the tissues removed, showing that essentially the same process was at work throughout the mouth. In all there was marked hypertrophy and œdema of the mucosa, with here and there considerable downgrowth of the epithelium. The submucosa was œdematous and markedly infiltrated with lymphocytes, leucocytes, plasma cells and fibroblasts. The diagnosis in all was chronic inflammation of gum (Fig. 4).

Throughout the remainder of her pregnancy there was no recurrence of the excised growths, but considerable enlargement of the palatal growth, which had not been touched. In January, 1923, she was delivered of a normal child.

Six months later, she was again seen. The marked gingivitis and hyperæmia, which had been present when she was first observed, had practically entirely disappeared. No recurrence of the excised growths had taken place. The only growth still remaining was the large one between the upper left first and second molars on the palatal aspect. It had diminished considerably in size and was now slightly less than 1 centimeter in diameter.

In May, 1924, she was again seen. She had had a spontaneous abortion of a few months' old fetus in August, 1923. Upon examination of her mouth, there was found to be no recurrence in the right cuspid region which was normal. However, the palatal growth was considerably larger than when seen 10 months before. It was almost 2.5 centimeters in diameter from before backward, and 1.2 centimeters from above downward. It was afterwards ascertained that at the time of this examination, she was just at the beginning of her third pregnancy.

In February, 1925, she was again observed. She was now in the ninth month of her third pregnancy. Since its onset, she had noted a progressive increase in size of the palatal growth. It was now 3.5 centimeters long by 2 centimeters wide, extending over the palatal aspects of the first, second, and third molars and back over the tuberosity. Throughout

Fig. 4. Case 1. Drawing from photomicrograph.

the mouth there was present a gingivitis almost identical with that observed during her first pregnancy, with here and there smallish proliferations of tissue and a larger one, ½ centimeter in diameter, arising from the buccal interdental space between the upper right second bicuspid and first molar. There was no recurrence at the site of removal of the large growth between the upper right cuspid and first bicuspid present during her first pregnancy.

A few days later, she gave birth to a normal child. Immediately thereafter, the growths began to diminish in size. Six weeks after delivery, the dimensions of the palatal growth were 2 centimeters by 1 centimeter, as compared with 3.5 centimeters by 2 centimeters just before delivery, and its volume was only one-third as much. (Fig. 5.)

Ten weeks after delivery, the growth was of practically the same size. The patient refused to have it excised, therefore the effect of radium was tried. Dr. Craver applied to the growth 1,800 millicurie units of unfiltered radium emanation. Ten days later, it was much flatter, with here and there small areas of beginning necrosis. Unfortunately, the patient was then lost track of and has not been seen since. However, there is no doubt in my mind, in view of the well known effects of radium and X-ray upon inflammatory growths, that either of them is capable of effecting the disappearance of this type of growth, especially if they are used in conjunction with periodontic treatment.

Case 2. Mrs. P., white, American, 27 years old, was first observed on April 23, 1923. About 2 months before, during the fourth month of this her third pregnancy, she had noticed that the gum between the lower left lateral incisor and cuspid teeth was

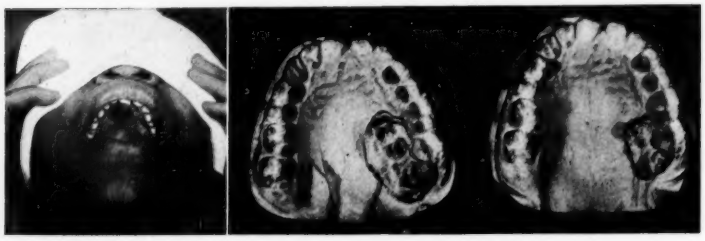

Fig. 5 (left). Case 1. Photograph showing growth in third pregnancy.
Fig. 6. Case 1. Casts showing size of palatal growth 2 days before and 6 weeks after delivery.

beginning to grow up toward the incisor edge. It has since been steadily increasing in size.

She had 2 children, both alive and well, and had had no miscarriages. The general physical condition was good, and the blood Wassermann reaction and urinary findings were negative.

Upon examination, her mouth was found to be in a filthy condition. The teeth were extremely dirty and had considerable calcareous deposits about their necks. Most of them were loose, especially the lower anteriors.

The growth was situated between the lower left lateral incisor and cuspid teeth, which were separated from one another by a space of 1 millimeter. It was 1 centimeter high by 5 millimeters wide, attached by a pedicle to the distal aspect of the peridental membrane of the lateral incisor, from which it extended upward to the level of the incisor edge of the teeth. Mesially, it covered almost the entire surface of the lateral incisor and distally the mesiolabial angle of the cuspid. It was rather soft in texture, did not bleed readily, and was reddish purple in color. It could be easily reflected labially, showing on its lingual surface the indentation of the labial surface of the lateral incisor and a prolongation backward into the interspace between the lateral and cuspid.

The gum tissue below the growth was red and hypertrophied. Extending backward on both sides into the molar region was an inflammatory rim of gingival tissue, about 1 millimeter in diameter. It was of a bright red color and contained numerous dilated blood vessels, which ran in a direction perpendicular to the free edge of the gingiva. This gingival rim was freely movable away from the surface of the teeth and showed many slight breaks running in the same direction as the dilated blood vessels. The lingual surface was free of gingivitis, except back of the lower incisors and left cuspid, where it was present to a slight degree. On the labial surface of the upper incisors, cuspids, and bicuspids, the same type of inflamed gingival rim was present. The molars and the lingual side of all the upper teeth were free. Pus could be expressed from the necks of all the involved teeth.

Roentgenograms showed that all of the teeth had extraordinarily short roots. In many there appeared to have been resorption of some of the apical portion. This was especially marked in the bicuspids and anterior teeth. The lower left lateral incisor showed considerable destruction of its alveolar attachment, especially on its distal side, where the growth was present.

This patient was permitted to go to term without any operative interference. The growth increased progressively and at the time of delivery was 1.4 centimeters high by 8 millimeters wide. She gave birth to a normal child. Two months later the growth had diminished to the size first observed, and was excised.

Microscopic examination. The mucosa was thickened and œdemátous and sent numerous prolongations downward into the underlying stroma, but did not resemble carcinomatous tissue; it was infiltrated was polymorphonuclear leucocytes. The submucosa was considerably thickened and infiltrated with large numbers of small round cells. Here and there were several small masses of calcified material. The diagnosis was chronic inflammation of the gum.

This patient was again seen 6 months later, in April, 1924, also in October, 1924, and in May, 1925. There was at no time a recurrence of the growth. She had not become pregnant in the interval.

Case 3. E. L., American, white, aged 27, came under observation in July, 1923. At about the beginning of April, 1923, during the seventh month of her first pregnancy, she had noticed the beginning of a growth on the buccal side of the lower right third molar. It had gradually increased in size, until at the beginning of June, she stated that it was almost 2 centimeters in diameter. At this time, she was delivered of a stillborn child. Soon thereafter, the growth began to diminish in size and was 1 centimeter in diameter in July, when first seen.

Upon examination, her mouth was found to be unclean, large deposits of tartar being present about the necks of all the teeth and green stain on the upper incisors. There was throughout, especially on the buccal aspect of the teeth, a purplish red rim, about 1 millimeter in diameter, of inflamed gingival tissue, with injected blood vessels.

On the buccal side of the lower right third molar tooth, midway between the mesial and distal surfaces, was a reddish purple colored mass, cauli-

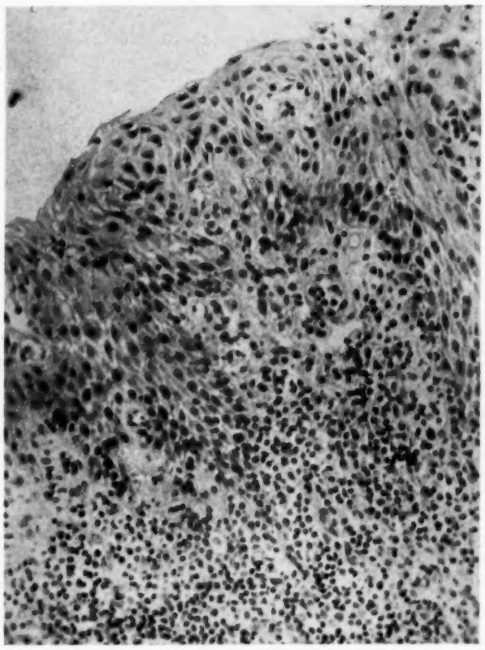

Fig. 7. Photomicrograph of specimen from Case 3.

Fig. 8. Photomicrograph of specimen from Case 4.

flower-like in appearance, about 1 centimeter in diameter, freely movable and attached by a narrow pedicle to the midpoint of the gingival margin of the gum. Between the lower right second and third molars, in the interspace buccally, there was a small mass of hypertrophied gum tissue, about 1 millimeter in diameter. She stated that a growth, similar to the one described above, had been present in this area and that it had been about 3 millimeters in diameter before delivery. This is interesting, in view of the condition found 10 months later.

There was a fixed bridge present, consisting of a gold shell crown upon the lower right second molar and one upon the lower right second bicuspid, supporting an artificial molar. Both crowns fitted poorly. There were no spaces between any of the teeth.

The blood Wassermann and urinary findings were negative.

The larger growth was excised in July, 1923.

Microscopic examination. The specimen was covered with alveolar mucosa, which sent extensive prolongations downward into the underlying stroma. These epithelial masses were made up of apparently normal cells. In the stroma there was marked round cell infiltration. The growth was probably an epithelial and connective tissue hyperplasia due to chronic inflammation. (Fig. 7.)

In May, 1924, 10 months after the growth had been excised, the patient was again seen. She was again pregnant, in her seventh month. There was no recurrence at the site of the previous excision. However, between the lower right second and third molars, arising from the interspace, was a small pedunculated growth, 5 millimeters high by 3 millimeters wide. It was dark red in color and freely movable. She had noticed it beginning to form the month before. As will be recalled, this area was the seat of a small growth during her first pregnancy.

In October, 1924, three months after the birth of a normal child, the mass had completely disappeared without any operative interference.

In June, 1925, the patient was seen again. The gums were in fair condition. There had been no recurrence; she had not become pregnant in the interval.

CASE 4. S. A., white, Armenian, aged 22, was first seen in November, 1922, during the eighth month of her first pregnancy. Six months before, she had noted the beginning of a growth between the lower left central and lateral incisors. It had grown progressively larger during the interim.

There was present in her mouth the same type of injected gingival tissue as in the other cases observed. Deposits of tartar were present about the necks of most of the teeth. Between the lower left central and lateral incisors could be seen the growth, a freely movable, purplish red mass, 1 centimeter high by 1.5 centimeters wide, attached by a pedicle

to the gingival gum tissue and extending upward almost to the incisor edge of the above teeth.

The growth was excised by Dr. Fred S. Dunn.

Microscopic examination. The mucosa was hyperplastic. Beneath it was a large mass of newly formed blood vessels, surrounded by leucocytes, plasma cells, lymphocytes, and some fibroblasts. In another portion was a large area of round cells. The diagnosis was chronic inflammatory tissue. (Fig. 8.)

Unfortunately this patient was not followed up.

CASE 5. B. N., white, American, aged 25, came under observation in April, 1925, during the eighth month of her first pregnancy. At the beginning of the seventh month, she had noticed that the gum between the lower right first and second bicuspids was increasing in size and bled rather easily. During the next month, it became gradually larger, extending upward toward the occlusal edge of the teeth.

Upon examination, her teeth and gums were found to be in fair condition. As marked a generalized gingivitis as was seen in the other cases reported was not present. There was some calculus about the necks of the teeth, but no marked inflammatory changes, except in the region of the growth. Here the gingiva was reddened and passing up from a pedicle was a freely movable, reddish purple, lobulated mass of tissue, 7 millimeters high by 5 millimeters wide.

During the ninth month, the growth increased slightly, being 8 by 5 millimeters at delivery. Immediately thereafter, it began to regress and 2½ weeks later, only a reddening and slight thickening of the gingival tissue showed where the growth had been.

CASE 6. S. K., a Polish woman, 22 years old, was first observed on September 30, 1925, 4 days after the birth of a normal child. About 1½ months before, she had noticed the beginning of a growth back of the lower anterior teeth. It had increased progressively in size during the remainder of her pregnancy, which was her second.

The general physical examination was negative; the urine was free of abnormalities. The mouth was in a filthy condition, with much calculus about the necks of most of the teeth. There was a marked gingivitis throughout, especially on the labial aspect of the lower incisors. Between the lower left central and lateral incisors, springing by a narrow pedicle from the distolingual aspect of the central, was a reddish purple mass, 2 centimeters in diameter, similar in character to those already described. The physician who had delivered her stated that the growth was already smaller than when she had come to the hospital 4 days before. Eleven days later, without treatment, the growth had diminished in size to less than 1.5 centimeters in diameter and was excised.

Microscopic examination showed the mucosa thickened, with considerable new formation of branching bundles of fibrous tissue surrounded by lymphocytes and plasma cells, the whole picture being one of chronic inflammation. (Fig. 9.)

Because of the fact that these growths usually appear during pregnancy, tend to increase in size during that period, regress after delivery, are composed of chronic inflammatory tissue and are, as a rule, part and parcel of a generalized gingivitis, I have proposed for the entire condition the name of "proliferative gingivitis of pregnancy." I believe that the term proposed is more descriptive and inclusive than the one occasionally used for the milder types, namely "hypertrophic gingivitis of pregnancy," because it immediately calls attention to the fact that the gingivitis presents the appearance of tumor-like masses. It should, however, be distinctly understood that we are dealing here not with real tumors, but only with inflammatory proliferations of gum tissue.

ETIOLOGY

Brophy (2) has attempted to explain this condition by stating that during the period of gestation, the whole organism seems to be endowed with a tendency toward the multiplication of cells and that therefore the gums respond in like manner under irritation. This explanation does not appear to me to be plausible for two reasons: first, because there is no evidence that I have been able to find that the cells in any part of the body, other than those in the organs associated with the growth and nutrition of the fetus and the infant, are endowed during pregnancy with a tendency toward multiplication; and second, because the response of the gums in these cases consists not primarily of a multiplication of cells of the gum tissue, but principally of a pouring out of the products characteristic of a chronic inflammatory process, namely, tissue fluid, lymphocytes, plasma cells, and fibroblasts.

I believe that we must seek the explanation for the changes described along other lines. It has been noted that in practically all the cases I have reported, the patients' mouths have been generally quite unclean, with considerable deposits of tartar about the necks of the teeth. This would suggest that, in all probability, even before they had become pregnant, their gums had been the seat of a variable degree of gingivitis. Under the

Fig. 9. Photomicrograph of specimen from Case 6.

influence of pregnancy, the inflammatory response becomes intensified. What had till then called forth a moderate reaction, now causes an increased outpouring of the products of inflammation.

One may speculate as to the causes of this apparently increased inflammatory response. Is it due to changes in the chemical composition of the blood stream or is it a vasomotor phenomenon? Does it perhaps depend upon an increased production of some endocrine product or possibly upon diminished resistance of the tissues during pregnancy? The question is worthy of further study.

The regression after delivery can be explained along similar lines. Microscopically the regression can be seen to be due to a rapid diminution in the œdematous condition of the mucosa and submucosa.

IS THERE A GINGIVITIS PECULIAR TO PREGNANCY?

At this point we can consider the question as to whether or not there is a gingivitis, especially and alone connected with pregnancy. On this matter I am disposed to agree with Coles (3) who stated that there was not. An examination of a few hundred mouths of pregnant women of all classes of society will show, in some, the presence of gums of normal health, in others, of a moderate gingivitis and in still others of an advanced gingivitis, with marked proliferation in a few. There is nothing distinctive about the gingivitis found in pregnancy, with the possible exception of the marked œdematous condition of the tissues. A long continued irritant upon the gums in many cases will call forth a productive inflammatory reaction almost identical with that observed in the cases I have described and may be seen in women who are not pregnant and in men. Only a short time ago, I noticed a tumor-like mass about 8 millimeters in diameter springing from the palatal aspect of an upper third molar in a woman of 55, a diabetic, who had not been pregnant for 30 years. She had noticed its presence for the past year. Macroscopically and microscopically, it was practically identical with the growths I have observed in pregnant women. Hirschfeld (6) has also observed an inflammatory growth, similar to the type observed during pregnancy, in a man of 34.

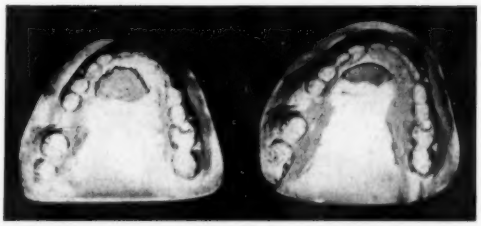

Fig. 10. Case 6. Casts showing size of growth 4 days and 15 days after delivery.

If there is then no gingivitis especially and alone connected with pregnancy, why speak of a proliferative gingivitis of pregnancy? For two important reasons: first, because the proliferation of gum tissue increases rapidly during pregnancy and ceases with its termination; and, second, because our attention should be directed to the inflammatory nature of such growths so that we may differentiate them from true tumors.

TREATMENT

The condition being entirely inflammatory, it is essential that preventive treatment be carried out on women before they become pregnant. This should consist in a thorough cleaning and scaling of the teeth, the removal of all badly decayed teeth and poorly fitting dental restorations, the correction of abnormalities of occlusion, a course of massage of the gums, and instruction as to the proper methods of using the tooth brush. In other words, all possible sources of irritation to the gums should be eliminated and the tissues brought to a state of normal health.

Should the gingivitis be observed during pregnancy, the above outline of treatment should be instituted immediately. By such means, Hirschfeld (6) treated 2 cases and effected a considerable diminution in the size of the growths present while the women were still pregnant.

If the growths do not disappear under such treatment, they need not be removed during pregnancy unless they interfere with the comfort or masticating ability of the patient. After delivery, because of the rapid diminution in size, they can more easily be dealt with and the tendency toward a recurrence is not so great. No teeth need be sacrificed during the process of removal.

CONCLUSIONS AND SUMMARY

1. Six cases are reported in which tumor-like masses were observed forming on the gums of pregnant women. They began to form at a variable time during pregnancy, increased in size unless treated, and spontaneously diminished in size or disappeared completely after delivery.

2. The growth, which attracts our attention because of its size, is not, as a rule, an isolated thing in these cases. It is usually accompanied by a generalized gingivitis and represents simply an exaggerated degree of this condition. The name proliferative gingivitis of pregnancy is proposed for all phases of the condition.

3. This type of growth is inflammatory and should not be classed as a tumor.

4. There is no gingivitis peculiar to and found only in pregnancy. A gingivitis practically identical with that described may be seen at times in men and in women who are not pregnant.

5. Elimination of all irritating factors, and, if necessary, excision of the growth about a month or two after delivery, should constitute the treatment.

In closing, I wish to thank Dr. W. C. Clarke for assisting in the examination of some of the microscopic sections, Drs. Douglas Symmers and George H. Semken for many valuable suggestions, Dr. H. S. Dunning, in whose clinic several of these patients were first seen, Dr. I. Hirschfeld for permission to use some of his material, and Dr. A. Jutkowitz for the preparation of the casts shown.

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TORULA INFECTION IN MAN, REPORT OF A CASE[1]

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THE following case of inguinal abscess from which a torula was isolated in pure culture is of interest on account of (a) the rarity of torula infection in man, seventeen authentic cases having appeared in the literature, (b) its unusual occurrence in the colored race, (c) the local type of infection, and (d) the unusual clinical course with recovery.

A brief review of the literature, the clinical and bacteriological findings, including animal experimentation and illustrations, and a comparative discussion of the clinical and bacteriological findings of other authors in relation to those of our case will be presented.

The classification of diseases due to yeast-like organisms has proved difficult.

Busse (3) in 1895 reported the first case due to a true yeast. Gilchrist (8) in 1896 described a case due to blastomyces, and Rixford and Gilchrist (13) in the same year described the organism, coccidioides immitis. Brewer and Wood (2) in 1908 reported a case of abscess of the vertebral muscles, due to a "blastomyces," which was cured by operative procedures. In the light of more recent knowledge it was undoubtedly a torula infection and is accepted as such in the subsequent literature. It is the only case not systemic in type but local and ending in recovery. Wolbach (20) in 1915 subdivided the blastomyces into (a) blastomyces, yeasts which grow out in mycelium and form endospores; (b) torula, yeasts which do not grow out in mycelium nor form endospores. He surmised from the gelatinous character of the lesions due to zooglia formation found in the sections that the two cases of Rusk (14) reported as blastomycosis were actually torulæ, although cultures were lacking. Stoddard and Cutler (18) established torula as a clinical and pathological entity. They differentiated it from blastomycosis on a clinical, pathological, cultural, morphological, and experimental basis. Shapiro and Neal (16) reported a case of torula meningitis of 5 months' duration in a boy 16 years old. Various methods of treatment failed, including the use of serum of rabbits immunized with torula. Freeman and Weidmann (6) reported a case of torula and also reviewed the literature. They brought forth evidence to disprove the accepted theory that cysts of the brain are formed by lysis of tissue due to the specific biological activity of the organism, as stated by Stoddard and Cutler (18). Sheppe (17) reviewed the literature and found that torulæ could be recovered from experimental animals although no lesions were evident grossly or microscopically. Hansmann (10) reported a typical case with central nervous system involvement. Bettin's case (1) brought the total to seventeen. Hranova (11) found torula on the tonsil of a young girl and this suggests the tonsil as a possible portal of entry. Sanfelice (15), and others, have isolated torula from human malignant tumors, and these strains in the hands of Nichols (12) have proved pathogenic for rabbits and guinea pigs.

In animals, Frothingham (7) isolated the torula from a case arising spontaneously in a horse, and produced typical lesions in guinea pigs and rats.

In nature, torula is widely distributed, occurring in the soil, breweries, on trees, fruits, in and on wasps and bees, in compressed yeast, olive oil, and butter (9).

REPORT OF CASE

L. M., negro, female, aged 26 years, was admitted to Memphis General Hospital December 8, 1924, complaining of pain and swelling of left groin. The family and past history was negative.

The present illness began in August, 1924, with vaginal discharge and pain in the left lower abdomen, radiating down the left leg to the knee. Pain was of a dull, aching character, increased by movements. Patient was up and about her home, attending to her duties. Sixteen days previous to admission to the hospital, a swelling appeared in the left groin which was accompanied by intense pain in the region of the swelling. The swelling increased in size,

[1] Read before the Southern Surgical Association, Louisville, Kentucky, December 15 to 17, 1925.

Fig. 1. Sagittal section showing left half of pelvis and upper left thigh. *A*, Abscess in inguinal region communicating through femoral canal, *B*, with extraperitoneal abscess in pelvis, *C*. *D*, Symphysis pubis. *E*, Uterus. *F*, Bladder.

Fig. 2. Smear of pus from inguinal abscess of human case fixed and stained by Michelson's technique. *a*, Torula phagocytized by large mononuclear leucocyte, showing capsule. *b*, Another large mononuclear. *c*, Polymorphonuclear leucocytes. *d*, Red blood cells. ×850.

and patient was confined to bed on account of the pain and high fever.

Physical examination revealed a well developed and fairly well nourished negro female, lying in bed, apparently suffering considerable pain. Temperature, 101 degrees; pulse, 135; respiration, 24; and blood pressure, 112–80. Examination of the head including the eyes, ears, and nose was negative. The tonsils were hypertrophied, ragged, and hyperæmic. The thyroid gland was negative. There was a moderate adenopathy of the cervical glands. The lungs and heart were negative. The abdomen was normal in contour and negative throughout except for pain, tenderness, and rigidity over the left lower quadrant. Examination of the sexual organs showed a moderate vaginal discharge, mucopurulent in character. The uterus was high up, pushed over to the right and more or less fixed. To the left of the uterus, there was an ill-defined, fluctuating mass which occupied the left vaginal fornix and displaced the vagina to the right, and which appeared to be continuous with the swelling which was apparent in the left inguinal region. A sense of fluctuation was obtained over the inguinal mass by palpation over the mass in the left pelvis (Fig. 1). The skin was warm and moist.

Laboratory findings. The urine (catheterized specimen) was of amber color; with specific gravity, 1,028; reaction, acid. Two or three pus cells to the high-power field were found; otherwise, negative. Blood count showed: white cells,24,800; polymorphoneutrophiles, 68 per cent; lymphocytes, 25 per cent; large mononuclears, 7 per cent; eosinophiles, none; basophiles, none. Wassermann test showed negative reaction. X-ray of spine and pelvic bones showed them to be normal.

Provisional diagnosis. Inguinal abscess, originating as a pelvic infection, dissecting down the femoral canal.

Progress notes. Diurnal variation of the temperature was from 100 degrees a.m. to 103.6 p.m. The pulse ranged from 100 to 120; respiration from 22 to 28.

On December 13, under ethylene anæsthesia, an incision was made over the fluctuating mass in the inguinal region evacuating a large quantity of pus. Digital examination of the abscess cavity in the groin showed that it communicated with another cavity in the pelvis by way of the femoral canal. The canal was large enough to admit the index finger. Evacuation of the abscess in the groin was followed by immediate disappearance of the pelvic mass. Some of the pus was submitted to the laboratory for examination.

Following incision and drainage, the temperature and pulse dropped to a lower course. For a period of 6 days the temperature ranged from 99.4 degrees to 100.4 degrees, and the pulse from 92 to 110, after which time a higher course was assumed, temperature ranged from 101 to 103 and the pulse from 100 to 130. The temperature was of the remittent type.

The local condition cleared up rapidly and had ceased discharging by the twenty-sixth day after the patient entered the hospital. Yet, the degree of toxæmia was apparently more marked. The temperature range was from 102 to 104 degrees and pulse

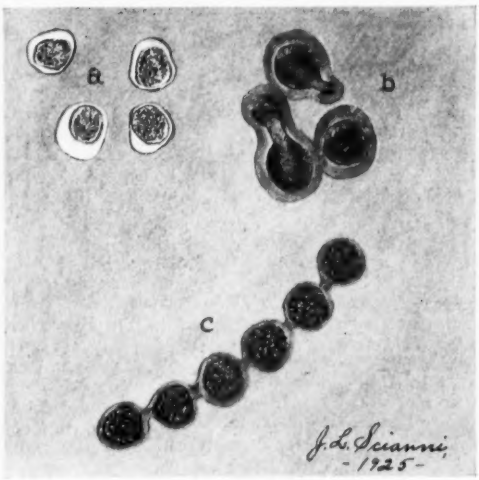

Fig. 3. Smear of pure culture of torula isolated from inguinal abscess of human case stained by Gram Weigert stain. *a*, Torula with capsule unstained. *b*, Torulæ with stained capsule in the act of budding. *c*, Torulæ with stained capsular matrix connecting cells. ×850.

range from 120 to 138, and on the thirty-third day of the disease the temperature reached 105 degrees. On the forty-first day of the disease, the temperature became intermittent in type, ranging from normal to 103. It remained thus until the forty-seventh day of the disease, when it again became remittent in type, gradually declining and reaching normal on the seventy-fifth day after patient's entrance into the hospital.

The degree of toxæmia in this case was marked from the beginning. The urine remained normal throughout. The leucocyte counts were of interest in that they were characterized by high total counts ranging from 15,000 to 24,000 with a low neutrophile count never going above 68 per cent.

On the thirty-first day of the disease, the patient developed a cough with expectoration and complained of pain in the left chest. Physical examination of chest revealed a few râles in the left base but repeated sputum examinations were negative for tubercle bacillus and torula. Throughout the course of the disease the patient was given one dram of saturated solution of iodide of potash, three times a day, alternating with sodium iodide intravenously. She was discharged on March 1, 1925, having remained in the hospital eighty-four days.

The patient was seen and examined on November 13, 1925, at which time she reported to have been in the best of health since discharge from the hospital over 8 months before. She had regained her weight and felt perfectly well. A pelvic examination at this time revealed no abnormality and there was not the slightest evidence of the infection which was present

Fig. 4. Spleen of guinea pig showing lesions of torula after intracardiac injections of a 24 hour pure culture of the torula isolated from the inguinal abscess of the human case, and external view, sectioned surface.

on her admittance. Uterus was freely movable, normal position, all thickening at the base of the broad ligament had entirely disappeared.

Bacteriological findings. The pus from the inguinal abscess was thick, creamy, and gray. Smears stained with Gram's showed 94 per cent polymorphonuclears, 7 per cent large mononuclears, a few red blood cells, and many double-contoured, yeast-like bodies. These varied in size from 7 to 15 micra, were usually round, but a few were oval; only two budding forms were seen. The walls stained easily, varied in thickness, being well developed in the large form and very fine in the small forms. Surrounding the cells was a capsular matrix which did not stain in the majority of cases but sometimes took the acid dye. The protoplasm stained diffusely but poorly, being unstained in the majority of cells. No pyogenic bacteria were observed. Acid fast stain was negative.

With 20 per cent sodium hydroxide, the double wall was brought out in greater detail and each cell was seen to contain one to five spherical, highly refractile granules. Some of the cells were vacuolated. The capsular matrix of the organism was easily distinguished.

The specimens were fixed with potassium bichromate and stained with Loeffler's alkaline methylene blue.[1] The cells showed one to five bluish-staining granules, phagocytosis by large mononuclears was rather frequent (Fig. 2). The organisms occur singly or in pairs.

[1]This technique of staining torula and similar micro-organisms was devised by Dr. I. D. Michelson and is as follows: A thin smear of the organism on a slide is air dried and fixed in a 1% aqueous solution of potassium bichromate for 1 minute. Washed in water and stained with Loeffler's alkaline methylene blue for 1 minute. Washed in water and dried by blotting, the morphological characteristics were best seen. Capsules were stained blue or green.

On culture, the same organism is grown from the pus in pure form as was seen in the direct smear. It shows the same general morphology (Fig. 3) except that the capsular material became manifest only in old cultures and then appeared connecting the cells as well as surrounding them. In broth, the growth was poor, appearing as a thick adhering sediment with a tendency to grow up the sides of the tube. On Sabaroud's medium, the best growth was obtained. Colonies appeared in 24 hours, small, white, opalescent, and round, which enlarged rapidly, becoming coarsely granular and hemispherical, then thickly mucoid, stringy, and pasty with a tendency to heap up in the center. Finally, they became confluent. The color changed to a cream tint and then through varying shades of yellow to dark brown. On Sabaroud's slants, brownish pigmentation was most marked on the surface and could be scraped off, exposing a yellowish layer. On blood agar, the growth was sparse and discrete, occurring as small, grayish-white, round colonies. On Loeffler's blood serum, the growth resembled that on blood agar except that the colonies were smaller and more watery. On the following sugars in Smith fermentation tubes no fermentation was noted at the end of 7 days: dextrose, maltose, mannite, lactose, saccharose, levulose, nutrose, dextrin, salacin, inulin, and raffinose. Since it has been demonstrated (9) that the fermentation of yeasts is subject to change and that they can be adapted in their ability to ferment sugars, the organism was cultivated on various sugars for 3 months with negative results. There was no liquefaction of gelatin. There was no reaction in litmus milk. Indol production was negative. The organism reproduced by budding only. During the 12 months of cultivation, no mycelia have been noted. In old cultures, fat globules, one to three in number, have been seen in the cell, and resting cells have been observed. Grown on gypsum blocks at room and incubator temperature, no endospores have been seen. The hydrogen-ion range was from two to eight. Repeated blood cultures of the human case proved negative for torula and other pyogenic organisms. A special effort was made to demonstrate the gonococcus. Sputum was negative for tubercle bacilli. Smears and cultures of tonsils were negative for torula.

The following animal inoculations were done. A 24 hour broth culture of the organism isolated from the inguinal abscess was well broken up and injected into two guinea pigs and two rabbits which, at the end of 7 weeks, were killed. Guinea pig No. 1, which had received 1 cubic centimeter intraperitoneally, showed enlargement of the mesenteric lymph nodes. On section they were gray and soft. Guinea pig No. 2, which received 1 cubic centimeter intracardially, showed small, circumscribed lesions in the spleen (Fig. 4), liver, and kidneys varying in size from pin-point to 4 millimeters in diameter and in color from white to a dirty yellow. The small ones were firm, the larger ones were raised above the surface, softer in consistency, and surrounded by reddish zones. The mesenteric lymph nodes were greatly enlarged; on section, they were firm and dull in appearance. Rabbits Nos. 1 and 2, injected intraperitoneally and intravenously with 1 cubic centimeter, respectively, showed the same type of lesions, except that the lesions were much smaller, from pinpoint to pin-head in size. The brains were negative macroscopically.

Microscopically the smaller lesions proved to be either early abscesses with the normal tissue replaced by aggregates of polymorphonuclears, surrounded by a zone of congestion; or proliferative nodules composed of epithelioid and lymphoid cells. The larger ones (Fig. 5) were older abscesses with centers composed principally of polymorphonuclears with some large mononuclears and a periphery rich in fibroblasts and large mononuclears, surrounded by a zone of congestion. The brain and mesenteric lymph nodes showed also the smaller lesions.

The same organism with which the animals were inoculated was cultured from the lesions in the liver (Fig. 6) and spleen of pig No. 2 and kidneys of pig No. 1, and rabbits Nos. 1 and 2.

Summary of case. Patient first came under observation with a vaginal discharge and pain in the lower abdomen radiating down the left leg to the knee, of 4 months' duration. A mass appeared in the left groin 16 days before admission attended with pain and fever for the first time, necessitating the patient's taking to bed. The mass was evacuated and found to contain thick, cream-colored pus. The patient's discomfort was relieved for a few days only to be followed by high fever, lasting 74 days. Subjectively and objectively, her condition did not justify so high a fever. The whole picture was suggestive of gonococcæmia but smears and cultures for the gonococcus were negative. The total number of white blood cells was high, but the polymorphonuclears were low and there was a mononuclear increase. Torulæ were found in the pus, either lying free or phagocytized by mononuclears. It was grown in pure culture and proved highly pathogenic for experimental animals. The patient has recovered and is still living. It has been one year since her discharge from the hospital. A recent pelvic examination revealed no adhesions nor the usual residue of a gonococcal infection. As no other organism was seen or grown, we feel justified in attributing to the torula the etiological factor in this case.

The organism isolated from our case was identified as a torula because of the following characteristics: (a) yeast-like, double-contoured bodies which did not form mycelia or endospores; (b) it did not ferment any sugars. According to mycologists, torula is a genus including only yeasts which do not produce endospores. Our organism has stood true to the above characteristics over a 12 months' period of observation.

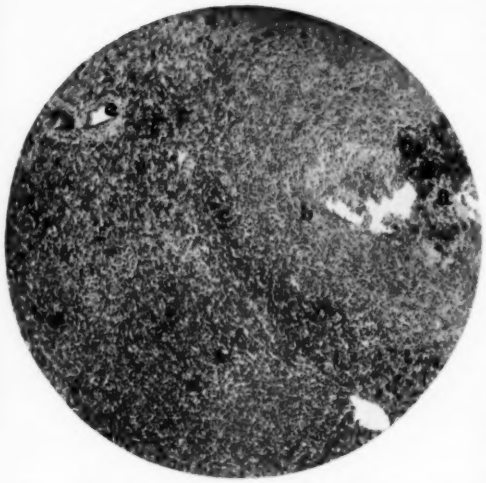

Fig. 5. Lesion of torula in liver of guinea pig the spleen of which is shown in Figure 4. *a*, Center of abscess composed principally of polymorphonuclear leucocytes with some large mononuclears. *b*, Periphery of abscess rich in large mononuclear cells and fibroblasts. *c*, Zone of congestion about abscess. *d*, Hepatic epithelial cells. *e*, Periportal space with bile duct, hepatic artery, and portal vein. ×45.

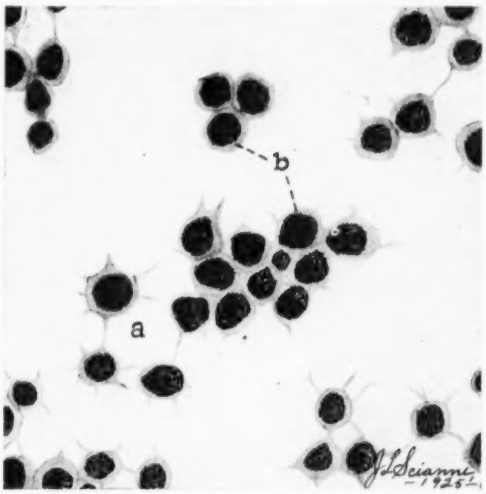

Fig. 6. Smear of pure culture of torula isolated from abscess of liver of guinea pig, shown in Figure 5, fixed and stained by Michelson's technique. *a*, Torulæ with stained capsular matrix connecting cells. *b*, Torulæ lying close together. ×850.

Clinically, cases of torula which have so far been recorded in the literature can be divided into: (a) The systemic type usually involving the central nervous system, simulating brain tumor and tuberculous meningitis. One case of pulmonary involvement has been described simulating tuberculosis, syphilis, and abscess of the lung. The white count is usually normal although in a case of Stoddard and Cutler (18) the count ranged from 10,200 to 34,300. The temperature is usually normal but may be elevated as in the above case (Stoddard and Cutler, 18) in which the temperature range was from normal to 103.8. All cases of the systemic type of torula infection have ended fatally. (b) The local type, exemplified by a case reported by Brewer and Wood (2), which was characterized by a localized abscess of the muscles of the vertebral column with slight fever, a white count of 21,000 cells, and a rapid recovery. Our case belongs to the latter group.

In our case a vaginal discharge followed by the appearance of a pelvic mass, the high, continued, remittent, and intermittent fever, forces one to rule out a gonococcus infection. Unfortunately, no vaginal smears were made. Smears from the pelvic mass were negative for the gonococcus or other pyogenic bacteria. Repeated blood cultures on media suitable for the growth of gonococcus were always negative. Clinically, if gonococcal in origin, it would belong to the type "Forme Prolonge" of Debré and Paraf (5) with emaciation, arthropathies, and usually death. None of these characteristics was present in this case. It is possible that the torula was a secondary invader overgrowing and replacing the gonococcus, but it was the only organism seen on smear or on culture. On the other hand, yeast-like organisms have been described by Van de Velde (19) in acute inflammations of the cervical mucosa or exacerbation of chronic, usually gonorrhœal, inflammations. In 9 cases, inflammation developed suddenly with itching and smarting, grayish-yellow discharge, redness and swelling of the vulva and vagina. Colpe (4) saw a long continued endometritis which he claimed was due to a blastomyces. Thus the original focus of infection in our case may well have been caused by a yeast-like organism. The temperature range of our case is different from that of

Brewer and Wood (2) both as to height and duration. The patient neither subjectively nor objectively appeared to be as sick as the temperature indicated.

The organism isolated from our case was similar to those described by others in its biological characteristics. Morphologically it differed in the difficulty with which its walls took the ordinary stains. Experimentally, although 9 months old, the organisms produced lesions in rabbits and guinea pigs more regularly and extensively than those of Sheppe (17) and those of Stoddard and Cutler (18) but less than those of Frothingham (7). Since Stoddard and Cutler used Frothingham's torula, it would appear that the organism loses its virulence on subculture. Therefore, our torula would have given even more extensive lesions probably if injected earlier.

CONCLUSIONS

1. Torula infection in man can be subdivided into (a) the systemic type, usually without fever or leucocytosis and always ending fatally; (b) the local type, attended with fever, leucocytosis, and recovery.

2. The case here presented belongs to the second group, the second of this type to be recorded.

3. This is the first reported instance in which a torula has been isolated from a negro.

4. Pathogenicity of torula varies in different strains and in the same strain on subculture. This may account for the difference in the clinical picture in man and the experimental picture in animals.

We are indebted for assistance in the study of this case to Dr. Harry C. Schmeisser and for the illustrations to Mr. Joseph L. Scianni, director and illustrator, respectively, of the Pathological Institute, University of Tennessee College of Medicine.

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SURGERY UPON THE TUBERCULOUS PATIENT[1]

By F. WEBB GRIFFITH, M.D., Asheville, N. C.

THIS brief paper does not deal with the surgical treatment of pulmonary tuberculosis but rather with the results of everyday surgical operations upon patients who are so unfortunate as to have pulmonary tuberculosis.

In a well regulated hospital the course and result of many infections can be charted, so that with a large series of cases one could tell fairly well what complications and what mortality might be reasonably expected. If surgical procedures were instituted, for instance during typhoid fever, the results could soon be accurately tabulated and the value of a given procedure determined. Pulmonary tuberculosis, however, does not run a regular course. Many cases with very slight tuberculosis and apparently in good physical condition rapidly go to a fatal termination.

On the other hand, it is not uncommon for an emaciated, desperately ill, tuberculous patient to begin almost suddenly and without reason to improve and to go on to cure and remain in good health until death from some other cause. For that reason we can establish no standard for control, and merely because a patient with pulmonary tuberculosis improves or becomes worse following a surgical operation is no positive proof that the operation is entirely responsible. However, 15 years' work among such patients does give me certain fixed ideas which, while not proved scientifically, I firmly believe. These ideas I present today for what they are worth.

ANÆSTHETICS

The tuberculous patient is below par and obviously the same care in every respect should be exercised in choosing the anæsthetic as in choosing an anæsthetic for any other substandard risk. With chloroform and spinal anæsthesia I have had absolutely no experience. Local anæsthesia with a preliminary hypodermic injection of morphine is by far the method of choice when it can be used. I once heard a prominent surgeon state that he seldom used local anæsthetics, for while he recognized their value he could not get through his day's work of several operations if he had to give the extra time necessary to operate under local. Such an attitude would be entirely out of place in the treatment of tuberculous patients just as it would in many other substandard risks.

For many years I tried to use nitrous-oxide oxygen out of deference to the wishes of some of our local chest specialists who insisted upon that particular anæsthetic. With this it was difficult for me to get complete prolonged relaxation as I have seen in some clinics. As a result, the patient was frequently straining at times when complete relaxation was most desired. If, as we are told, there is increased blood pressure under nitrous-oxide oxygen anæsthesia, that alone would increase the danger in tuberculous patients, especially those with a tendency to pulmonary hæmorrhage. I have almost completely given up this anæsthetic except when it is practically demanded by the chest specialists, and then I use it only under protest.

Ether has been by far the most satisfactory anæsthetic and I am convinced that if carefully given it does practically no harm to the lungs.

If the respiratory tracts of a large number of non-tuberculous patients were watched by the chest specialist as carefully for 2 or 3 days after operation as are these tuberculous cases, I firmly believe he would find just as large proportion showing bronchial irritation, a few râles, or possibly, a small patch of bronchopneumonia.

For the past 2 years I have been using ethylene to some extent. As yet my experience with it is too limited to form a conclusion, but it bids fair to rival, if not to replace, ether in these cases.

I have tried to analyze the results of one hundred consecutive operations upon patients under treatment for pulmonary tuberculosis. The indications were as follows:

[1] Read before the Southern Surgical Association, Louisville, Kentucky, December 15, 1925.

	Cases
Acute appendicitis (unruptured)	15
Ruptured appendix	5
Tuberculosis of cæcum, appendix, or peritoneum	19
Subacute or chronic appendicitis	15
(4 of which also had dilatation for dysmenorrhœa)	
Tuberculosis of kidney	1
Tuberculosis of testicle	3
Hæmorrhoids	3
Cauterization of cervix for leucorrhœa	2
Ischiorectal abscess	1
Ischiorectal fistula	1
Excision of persistent sinus of the chest	1
Tuberculosis of thumb	1
Pruritus perineii	1
(Area of skin size half dollar excised)	
Fibroid uterus	2
Curettage	3
(Hypertrophied endometrium with glandular dilatation)	
Chronic pelvic inflammatory disease with fæcal fistula from previous operation	1
Fractured patella	1
Cholelithiasis	1
(First operation drainage of gall bladder and appendectomy. Five months later cholecystectomy and drainage of common duct)	
Inguinal hernia	1
Dysmenorrhœa	1
(Dilatation of cervix)	
Parovarian cyst	1
Ovarian cyst	1
Termination of pregnancy	20

There were no operative deaths.

These cases were watched for a period of 2 months or longer to determine the results of the operations and the effect upon the lungs.

In the fifteen cases of acute appendicitis and the five cases of ruptured appendix the postoperative course and duration in hospital were about as usual. Upon discharge they were naturally a little weaker than they would have been had they been strong and robust before operation. While there was no demonstrable effect upon the lungs for a period of 2 months, yet the patients failed to gain in the fight against tuberculosis for that period of time. As, however, these were all operations of necessity there was no other choice.

There were 19 cases of tuberculosis of cæcum, appendix, or peritoneum, in other words abdominal tuberculosis. In no case was anything done except appendectomy and letting out the ascitic fluid if present. I did not feel justified in any of these cases in resecting even when the involvement seemed localized in the cæcum. Possibly I should have been more radical. In three cases there was complete symptomatic cure. In the other 16 the results were questionable. Most of them seemed to improve for a few weeks or possibly months, but the final results left much to be desired.

In the group of subacute or chronic appendicitis were 15 cases. Some of these were probably not appendicitis. The rest, forced feeding, and toxin of tuberculosis form a triad which at times plays havoc with digestion and give symptoms closely simulating the "indigestion appendix." When these symptoms of indigestion are interfering with the patient's recovery from tuberculosis, there is a big temptation to do an appendectomy. So that while in this group there were a minority who had definite pathological symptoms referring to the appendix and were greatly benefited or entirely relieved of the abdominal symptoms, the majority were unimproved. Apparently, in none of these cases was the lung condition made worse.

The patient with tuberculosis of the kidney, apparently unilateral, was not improved at all by the operation. If anything she was made worse and died 3 months later of acute miliary tuberculosis.

Removal of tuberculous testicles, of ovarian and parovarian cysts, of hæmorrhoids, cauterization of the cervices with actual cautery for profuse leucorrhœa, drainage of an ischiorectal abscess, cure of the ischiorectal fistula, excision of a sinus of the chest, excision of the end of a thumb for tuberculosis, excision of the area of skin of the perineum involved in pruritus perineii, all of these operations gave great benefit when the source of constant irritation was removed and the patients thereby enabled to fight better the pulmonary tuberculosis.

In the two cases of uterine fibroids, hæmorrhage was the indication, and as the patients were rather young, hysterectomy was done instead of radiotherapy in order to save the ovaries.

Curettage in the two cases of hypertrophied endometrium with glandular dilatation

checked the menorrhagia and thereby lessened the drain upon the patients.

Removal of the uterus and adnexa and closure of the fæcal fistula in a case of chronic pelvic inflammatory disease lifted such a load from the patient that the pulmonary lesion immediately improved. The cough, expectoration, and the physical signs of activity in the lungs which had been present for 2 years completely disappeared in a few months after operation.

There comes occasionally to every physician and frequently to those of us who are gynecologists the necessity for deciding whether or not the life of the fetus should be sacrificed in the interest of the mother. In every one of the twenty cases of this series there were two consultants who shared the responsibility with me, one of whom was the lung specialist who had been treating the patient.

In a health resort like Asheville it is not surprising that pulmonary tuberculosis should not only head the list of causes for therapeutic abortion but should exceed all other causes combined. Just what is sufficient indication to justify emptying the uterus in a tuberculous patient is still a much mooted question. You will see one patient who has apparently only a slight lesion, and that well arrested, pass through pregnancy nicely, and then after labor rapidly go to pieces, either by a flaring up of the pulmonary lesion or by a general miliary tuberculosis. On the other hand, one with an advanced lesion can occasionally go through without apparently doing much damage.

The patients with pulmonary tuberculosis who become pregnant may be roughly divided into three groups: (1) those in whom the disease is so markedly advanced that, regardless of pregnancy, the duration of life would be at the most only 2 or 3 years; (2) those in whom the disease is moderately advanced, and in whom the lesion may be quiescent, but who will always be tuberculous; and (3) those with incipient tuberculosis.

Paradoxical as it may seem, I believe that termination of pregnancy is most frequently indicated in the first and third groups.

In the first group, those who are, so far as we can tell, rapidly losing ground from the tuberculosis alone, it is wrong to allow them still further to hasten their end by the burden of a pregnancy when they may not even go to term.

In the incipient cases we have the other extreme. It is reasonably certain that such a patient could go through pregnancy and give birth to a healthy child. But it is almost just as certain that in the meantime she will have herself passed from the incipient to the moderately advanced group. In other words, by allowing the pregnancy to continue to full term she has thrown away her golden opportunity to get well. Isn't it much better, in such cases, to terminate pregnancy at the earliest moment before the tremendous strain is placed upon the lungs, and allow the woman to have her chance to become thoroughly recovered from her tuberculosis? Then, in a few years she may, with a minimum amount of risk, have not only one but several children and still maintain her health.

It is in the second or moderately advanced group that there is the greatest difficulty to decide.

In this group, if the patient has already one or two children, I still believe that her health comes first and that she is not justified in running the risk for the sake of further children. If, however, she is childless and is willing to accept the risk after it has been thoroughly explained to her, I believe the pregnancy should be allowed to continue under careful observation.

In a case in which the religious convictions of the patient do not permit of the termination of pregnancy under any circumstances, then the physician has no right to insist but merely explain the dangers and to advise accordingly.

In the 20 cases where pregnancy was terminated the duration of pregnancy estimated from the history and examination was as follows:

	Cases
First month	2
From first to second months inclusive	11
From two to three months inclusive	7

There were no cases after 3 months. The reason is that all the cases were under the

close observation of specialists in tuberculosis and when pregnancy occurred the question of termination was discussed. Our attitude has been that if termination is to be done, do it early and give the patient the maximum benefit. In no case in which pregnancy had been allowed to progress over 3 months did we feel it wise to interfere at a later date.

In three or four instances I have had to decide whether it was justifiable to terminate pregnancy the second time. The physical condition of the patient is the criterion and not whether a therapeutic abortion has been done before. I would consent to a second operation only upon condition that we go a step further and sterilize the patient. Some of these patients are young and while at the time not in shape to go through a pregnancy, yet it is possible that a few years later they may be so improved as to be perfectly justified in taking the risk. In such cases instead of doing the usual ligation and cutting of the tubes, it would be wiser to employ some of the methods which aim at temporary sterilization. The technique described by Carey Culbertson in 1917 appeals to me more than any other I have seen. This procedure leaves the tubes patent and opening into a small cul-de-sac in front of the uterus and completely cut off from the rest of the abdominal cavity.

Culbertson performed this operation thirty-one times but unfortunately has not yet had occasion to "unsterilize" any of the patients so that while it is very pretty theoretically it may not work out so nicely in practice. However, it gives the patient hope that some day she may still be in shape to become pregnant, and she is not so depressed mentally as is sometimes the case when a woman realizes that she is permanently and irreparably sterile.

CONCLUSIONS

1. Local anæsthesia should be used whenever possible. Ether does practically no more harm to the tuberculous than to the non-tuberculous lung and a general anæsthesia with ether should be employed whenever the necessity arises. Ethylene bids fair to replace ether in these cases.

2. Pulmonary tuberculosis is not a strong contra-indication to surgery. On the contrary, many patients are greatly benefited by the surgical removal of conditions which are indirectly retarding their recovery.

3. Whenever a tuberculous patient becomes pregnant intervention should be considered. If it is deemed wise to allow the pregnancy to go to full term, well and good; if, however, it is reasonably certain that intervention will have to be done it should be done early before irreparable damage has been done to the lungs.

RAT BITE FEVER
COMPLETE REPORT OF A CASE[1]

By WALTER E. HENNERICH, M.D., St. Louis, Missouri

RAT bite fever has been defined as an infectious disease, caused usually by the bite of a rat, and characterized by paroxysms of fever, by an inflammatory reaction at the site of the wound, by enlargement and tenderness of the adjacent lymph glands, and by a local or a general exanthema. The exciting factor is thought to be the spirochæta morsus muris although a streptothrix has also been described.

Since rat bite fever was first described by Wilcox in 1840, cases have been reported by various Japanese, French, English, and American authors. The Japanese have done extensive experimental work in connection with the disease and have contributed the greatest number of articles in the past few years. Some 140 odd cases have been reported since the above date, but only a few cases are in the United States, and as far as I can find in the literature only one case in the city of St. Louis, which was presented by Dr. John Zahorsky before the St. Louis Medical Society, on April 14, 1925.

That the disease is rare is readily established by the fact that we frequently find reports of cases of rat bite, yet seldom do we find a report of a case of rat bite fever. It would seem that only infected rats transmit the disease and also that the disease is more or less rare in the rat itself.

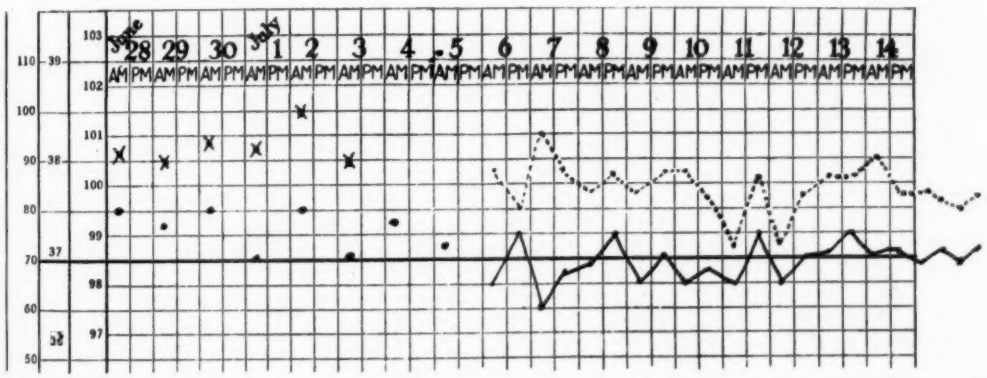
I wish to report a case which fits in well with the excellent discussion of Dembo et al in the *American Journal of Diseases of Children*, February, 1925.

C. A. H., white male, age 27, was bitten on the right hand by a rat on June 14, 1925. The wound bled a little and then healed, but on June 24 (10 days after he was bitten), the patient states that the hand again began to swell and become painful. After losing several nights of sleep, he came to me seeking relief, complaining of a swollen hand, with a throbbing pain, pain in the axilla, headache, fever, pain in the arms and legs, dizziness and fatigue.

The physical examination was negative except for the local condition, and enlarged, painful and tender epitrochlear and axillary glands (on the same side), and a morning temperature of 100 with a pulse of 92.

The hand and the lower one-third of the forearm, were swollen, painful, and tender, and on the dorsum of the hand between the fourth and the fifth metacarpal, was a bluish or a purplish discoloration, about 2 centimeters in diameter, about which was an area of redness. An incision was made but no pus was found. Bichloride packs were applied and the patient was advised to use continuous normal saline soaks.

The following day the pain was relieved, but for several days the other symptoms remained. No pus was found at any time. I advised the patient to



The temperatures from June 28 to July 6 were morning temperatures and consequently it is presumed that the afternoon readings would be somewhat higher.

[1] From the Surgical Service of the St. Louis University School of Medicine and the St. Mary's Group of Hospitals.

enter the hospital for a complete study of the case, which he did.

During this period, the discoloration at the site of the bite, had taken on a distinct purple hue, and several macules, about 3 millimeters in diameter appeared on the dorsum of the hand and the wrist, later developing into pustules.

He was admitted to the St. Mary's Infirmary on July 5, 1925, and assigned to the surgical service. The discoloration had now taken on the appearance of an ulcer 2.5 centimeters in diameter, with a central area of dry gangrene, 1.5 centimeters in diameter which soon sloughed off leaving a typical punched out ulcer, with a dirty gray base.

The complaint upon admission to the hospital was the same as previously, i. e., swollen and painful right hand, with a pain extending into the upper arm and armpit, headache, dizziness, and vague pains in the muscles and joints throughout the body.

The laboratory findings were as follows: The urine was amber colored; acid; specific gravity 1024; no albumin, sugar, acetone, or diacetic acid; no casts or pus cells. White blood count, 6,200; red count 4,900,000; hæmoglobin, 75 per cent; clotting time 3 minutes 20 seconds; Wassermann negative; blood pressure 110-65. Dark field, no spirochætæ found. Differential count: polymorphonuclears, 78 per cent; large lymphocytes, 12 per cent; small lymphocytes, 5 per cent; eosinophiles, 3 per cent; mast cells, 2 per cent. Blood sugar, 91 milligrams per 100 cubic centimeters of blood; non-protein nitrogen, 30 milligrams per 100 cubic centimeters of blood. Phenosulphonepthalein, 35-20—55 per cent.

Hot bichloride packs, 1:5000, were applied and salvarsan 0.4 gram given intravenously. Throughout his stay in the hospital, he complained of pain in various muscles and joints over the body, all of which subsided under the treatment.

He was discharged on July 25, 1925, as recovered, and 1 week later reported himself as "feeling fine."

NOTE.—Patient (C. A. H.) returned on March 3, 1926, stating he has been perfectly well. There has been no discomfort of any sort. The hand, as he states, is as good as ever.

The salient points in the diagnosis are:

1. Positive history of a rat bite.
2. Temperature curve typical of the cases reported.
3. Bluish discoloration at the site of the bite, with a local macular eruption about the hand and the wrist.
4. Inflammatory reaction about the site.
5. Enlarged and painful lymph nodes.
6. Incubation period of 10 days.
7. Vague muscle and joint pains.
8. Probable increase in the polymorphonuclears and decrease in the hæmoglobin.

CÆSAREAN SECTION AT THE COOK COUNTY HOSPITAL FOR THE PAST ELEVEN YEARS[1]

By HENRY F. LEWIS, M.D., Chicago
From the Obstetrical Service of the Cook County Hospital

IN the period from November 5, 1914, to August 27, 1925, there were 170 cæsarean sections performed in the Cook County Hospital, Chicago.

The histories of 12 of these, known by the records in the warden's office to have been performed during this period, cannot be found in the record vaults. The operating room statistics show that cæsarean section was done in the 12 cases and the mortality records of the hospital show that none of the 12 died. Therefore we can use for our critical studies only 158 cases.

During this period of 11 years there have been fifteen thousand deliveries at or near term in this hospital. There were 16 deaths in the 170 cases, a mortality of 9.4 per cent. We do not believe that we can be justly accused of doing an excessive number of cæsarean sections. In fact the incidence of these operations was 1.1 per cent, or 11 per 1,000. The number performed in 1914 was 3; in 1915, 4; in 1916, 8; in 1917, 6; in 1918, 9; in 1919, 5; in 1920, 10; in 1921, 16; in 1922, 19; in 1923, 23; in 1924, 33; in 1925 (8 months), 22; total, 158.

The increase since 1920 can be accounted for by two factors; first, that cæsarean section was not so popular more than 5 years ago as now; and, second, that the number of obstetrical cases admitted to the hospital has about doubled in the past 5 years.

My colleague, Dr. W. George Lee, has allowed me to use his statistics on the frequency of cæsarean sections in Chicago hospitals, taken from records for the year 1923. The estimate is based on the number of cæsareans per thousand obstetrical patients treated in each hospital.

The Cook County Hospital had 8 per 1,000; of the other hospitals, A hospital had 42 per 1,000; B hospital had 26 per 1,000; C hospital had 19 per 1,000; D hospital had 13 per 1,000; E and F each had 10 per 1,000. A total of 74 other hospitals in Chicago show an average of 19 per 1,000. It will be seen that the average of the County Hospital for the whole 11 years is 3 per 1,000 more than Dr. Lee's average for the single year 1923, namely 11 per 1,000.

A table showing the ages of our 158 patients follows:

Age in years	Cases	Age in years	Cases
Unknown	1	27	7
15	1	28	6
16	3	29	5
17	7	30	8
18	16	31	4
19	20	32	4
20	5	33	5
21	9	34	2
22	12	35	6
23	8	36	4
24	9	37	3
25	4	41	1
26	7	45	1
			158

To summarize: There were 90 patients between 15 and 24 years of age; 52 between 25 and 34; 15 between 35 and 45; and 1 case in which the age was not recorded.

The periods of gestation were as follows:

	Cases		Cases
Term	118	6 months	1
8 months	22	Beyond term	10
7 months	6	Unknown	1
			158

The parity of our patients was as follows:

	Cases		Cases
Unknown	7	VI	1
I	91	VII	2
II	36	VIII	1
III	7	IX	1
IV	8	X	1
V	3		158

There were 29 women who had undergone cæsarean section one or more times previously.

[1] Read before the joint meeting of the St. Louis and Chicago Gynecological Societies, St. Louis, Missouri, October 10, 1925.

Previous Cæsareans

Year	Cases	Year	Cases
1914	0	1920	1
1915	0	1921	2
1916	2	1922	2
1917	1	1923	9
1918	2	1924	3
1919	0	1925	7
			29

Brief accounts follow of 5 cases in which the woman was subjected to cæsarean section a second or third time in Cook County Hospital.

CASE 1. M. W., aged 16, had her first cæsarean section July 16, 1916. She was a primipara with a slightly justo-minor pelvis and a presenting head which remained floating for 15½ hours without advance. Shortly before the operation the cord prolapsed but remained pulsating. The child's head was held up by an assistant during the giving of the anæsthetic. The child, which survived the operation, was not of large size. The pelvic measurements were: interspinal, 22.5; intercristal, 25.5; intertrochanteric, 30.5; external conjugate, 19; conjugata vera, 9.5. The operation was of the classical type. The patient had a rather stormy course of septic type but was discharged on the twenty-eighth day in good condition. She was instructed to come into the hospital a month or more before term at her next pregnancy. (Until 1923 we had no prenatal clinic at Cook County Hospital.)

She came back September 10, 1917, about 6 weeks before estimated term. She had an uneventful time during this waiting period, and came into labor October 16, 1917. She was given a moderate test of labor, because of the border-line measurements of the pelvis and then was operated on by the classical method. Her temperature did not rise above 101 degrees and her course was almost afebrile. The child was large and there had been no advance during the test of labor. She left the hospital in good condition with her child on the sixteenth day after operation.

CASE 2. S. J., aged 35, had her first cæsarean section in the Cook County Hospital, February 27, 1918. She was pregnant at term with her fifth child. All former labors had been normal. Two months before entrance she had swelling of the legs, added to her general obesity. Three convulsions had occurred 14 hours before admission. She was not in labor. The head was movable above the inlet. The urine showed albumin, and hyaline, granular, and blood casts in abundance. The blood pressure was 170–110. The pelvis was adequate, measurements being: interspinal, 26.5; intercristal, 30; intertrochanteric, 35; external conjugate, 21.5.

The day of entrance she was operated upon by the classical method. She ran a moderate febrile course for about 8 days, the highest temperature being 101.4 degrees F. A stitch abscess developed in the wound above the navel, but healed before her discharge. She left the hospital on the sixteenth day after operation in good condition, with her child.

She again entered the hospital 2 years and 13 days after her last delivery, March 3, 1920, pregnant at term, suffering from pre-eclamptic toxæmia. A small ventral hernia had developed in the upper portion of the wound above the navel, where a stitch abscess had formed during the convalescence from her last cæsarean section. The urine contained pus and there was much dysuria. The condition continued throughout her stay in the hospital. Her convalescence was almost afebrile. She never showed a temperature over 100.2 degrees F. and that only for 9 days. The second operation was a classical one, with repair of the ventral hernia. There were many dense adhesions in the abdomen. Abdominal pain had been almost constant during the pregnancy. She left the hospital 20 days after operation well, except for slight pyuria, which still persisted.

CASE 3. L. G., aged 17, primipara, had her first cæsarean section September 13, 1918, under the indication of an irregular flat rachitic pelvis of the following dimensions: interspinal, 23; intercristal, 24; intertrochanteric, 28; external conjugate, 17; transverse diameter of outlet, 9. She was about 3 weeks before full term. She was kept in the hospital until term, when, under the influence of mild pains, the head, although easily movable became slightly engaged in the inlet. The operation was then performed by the classical method. She had a temperature of 100.4 degrees F. on the first day postpartum, but had an easy convalescence after 16 days.

She entered the hospital the second time June 3, 1921, because of advice given at her former discharge. Labor began 6 days after admission and the second classical operation was performed. The measurements at this time showed diameters slightly smaller than those given at the former operation. In addition, the right oblique external diameter was found to be 19 centimeters and the left 18. On admission she had an infectious swelling of the jaw and a smear, suggestive of gonoccocus, was taken from the vagina. She had no fever before the operation, afterward a mild fever for 3 days. The remainder of the convalescence was uneventful.

CASE 4. M. B., aged 18, had her first cæsarean in the County Hospital in 1920. The history of this case cannot be found. It is known, however, that she had been advised to return for her next labor. She entered the second time January 8, 1922, at full term. She had a generally contracted pelvis: interspinal, 22; intercristal, 24; intertrochanteric, 28; external conjugate, 16.5. The operation this time was the low cervical.

This patient's third cæsarean section was performed at the hospital by the same method. She was sterilized by imbedding of the tubes during this operation. She had a slight wound infection with a temperature running between 99 and 101.6 degrees for 13 days. She was discharged on the fourteenth

day, postoperative. The child was of moderate size, weighing 7 pounds 1 ounce.

CASE 5. L. L., aged 21, had three cæsarean sections in the County Hospital, the first being on August 19, 1920, the indication for which was an irregularly contracted pelvis. In the three operations there were slight differences as to the pelvic measurements, therefore I present the average of the three: interspinal, 23.5; intercristal, 25.5; intertrochanteric, 30; external conjugate, 18. The highest temperature reached was 100, on the first day after operation, but the course was afebrile thereafter. The type of operation was the low cervical. She was advised to return on the occasion of her next pregnancy. Her first labor had been without interference but the child was small, 6 pounds 14 ounces. The second child weighed 14 ounces more. It died within 4 hours with emphysema of the lungs, chest, and abdominal walls.

The patient did not return until she was again in labor, November 9, 1921. The indication was the irregularly contracted pelvis, overriding head, and no advance for 6 hours. The type of operation was an atypical low cervical cæsarean. She ran a slight fever ranging from 101.8 degrees on the third day to 99 on the sixth. From the latter date to discharge her convalescence was uneventful.

For the third labor she entered the hospital, after several visits to the prenatal clinic, and was under observation for about 29 days before labor began on March 19, 1925. The low cervical operation was done for the third time. She was then sterilized. She had an acute upper respiratory infection, beginning on the fourth day postpartum, with a temperature running as high as 103.2 down to 99.4 on the twelfth day.

The indications for cæsarean section in the 158 cases as recorded were as follows:

	Cases
Flat pelvis and previous cæsarean section	2
Generally contracted pelvis and previous section	21
Normal pelvis and previous section	1
Flat pelvis	14
Generally contracted pelvis	42
Contracted pelvis with forelying funis	1
Contracted pelvis and ovarian cyst	2
Normal pelvis with large child (overdue)	1
Funnel pelvis	2
Normal pelvis, long labor without progress	23
Placenta prævia and fibroids	1
Placenta prævia	11
Placenta ablata	2
Eclampsia	10
Nephritis with hypertension	1
Pre-eclamptic toxæmia	1
Chronic nephritis and coma	1
Previous difficult labor with stillbirth	1
Former hard labor with abdominal scars and adhesions	2
Breech presentation	1
Malpositions	3
Vaginal stenosis	1
Flat rachitic dwarf pelvis with fast fetal heart	1
Multiple fibroids	2
Absolute indication (exostosis)	1
Psychosis of pregnancy	2
Epilepsy	1
Intestinal obstruction	1
Carcinoma of stomach with hyperemesis	1
Oligohydramnios	2
Carcinoma of cervix	1
Septic meningitis (moribund) for sake of infant	1
No indication noted	1
	158

POSTOPERATIVE COURSE

As a means of briefly classifying the postoperative courses of our patients, I have divided them into four classes, depending upon the severity of the postoperative symptoms, including temperature, extent of infection, etc. I have adopted a tabulation based mainly upon postoperative temperature. In classifying according to this letter system, the time of beginning and the duration of the fever were also included in assigning a letter to each case. The postoperative temperatures and course were as follows:

Degrees F.	Class
Over 104	A
From 104 to 102	B
From 102 to 100	C
Under 100	D

The classical cæsarean was performed in 12 A cases, 21 B cases, 40 C cases, 14 D cases, with a total of 87 cases.

The low cervical section was done in 7 A cases, 8 B cases, 16 C cases, 4 D cases, with a total of 35 cases.

The transverse cervical section was used in 2 A cases, 2 B cases, 6 C cases, 3 D cases; total, 13 cases.

The longitudinal fundal section was used in 1 A case, 4 B cases, 9 C cases, 2 D cases; total, 16 cases.

The Porro cæsarean section was used in 1 A case, 1 B case, 2 C cases, 2 D cases; total 6 cases.

The vaginal cæsarean section was used in only 1 case, of A type.

The longitudinal fundal operation leads as to safety both in the mortality and in the morbidity tables. The transverse cervical comes next in morbidity but not in mortality. The low cervical comes after the longitudinal fundal in mortality but below the transverse cervical in morbidity. The classical operation

has a worse mortality record than any except the Porro and the vaginal but leads the two cervical operations in morbidity average. It must be remembered that the classical operation has been done by all of the operators and has been the operation performed for most of the severest and most neglected cases.

The highest morbidity of all cases, as indicated by highest temperatures, is A, 30; B, 40; C, 70; D, 18; total, 158.

The temperatures by percentages were as follows:

Operation	Class	Per cent	Class	Per cent	Class	Per cent	Class	Per cent
Classical	A	13.8	B	24.1	C	45.8	D	16.1
Low cervical	A	20	B	22.8	C	45.8	D	11.4
Transverse cervical	A	15.4	B	15.4	C	46.1	D	23
Both cervical	A	18.7	B	20.8	C	45.8	D	14.5
Longitudinal fundal	A	6.2	B	25	C	56.2	D	12.5
Porro	A	16.6	B	16.6	C	33.3	D	33.3
Vaginal	A	100	..	....	..	....	..	....

Among the 158 cases here reported we have had 16 deaths. This indicates a mortality of 10.1 per cent in the cases amenable to complete study. On the other hand, it must be remembered that there are 12 cases which cannot be completely analyzed because of the loss of the histories but which other records show did not die. Therefore a correct mortality record must include these cases in the percentage. We have then 170 cases recorded, with 16 deaths. Our true death rate consequently is 9.4 per cent.

Furthermore, our patients come from a class which is full of prejudice, which is mostly ignorant and largely poverty-stricken. They do not come to us early enough. Often they wait days before they consent to enter the hospital. Even if not infected they are often exhausted and their vitality is already sapped by the great ordeal, when they come in. Many of them are attended by midwives or by inexperienced neighbors. Very few have been under the care of experts before they are admitted, while few have had much prenatal care of any great value. We make efforts to find out whether they have had vaginal examinations before they come in or have otherwise run in danger of infection but their stories are often unreliable. In many instances we cannot employ measures other than cæsarean section on account of religious beliefs precluding destructive operations which, from a strictly scientific standpoint, should be applied. We are often driven to the cæsarean section against our judgment. If we had transcendent skill or divine judgment we should have a better mortality rate.

Since we have had our own prenatal clinic we have noticed some improvement and, I think, an improvement which is increasing with time, albeit rather slowly. The light of hope seems to be getting brighter.

FATAL CASES IN DETAIL

CASE 1. 1914. L. T., aged 28, parity unknown, pregnant 6 months, entered the hospital unconscious and not yet in labor. Her pulse was rapid and full, her breathing labored and noisy. The heart area was enlarged, the pulmonic and aortic second sounds were accentuated. Eclampsia began soon after entrance, followed by deep coma. The fetal heart tones were heard. The temperature was 102 degrees on entrance and rose to 105.8 on the third day. The urine held a large amount of albumin and the microscope showed hyaline casts and a few erythrocytes.

The woman appeared to be *in extremis* on entrance and a vaginal cæsarean was performed in the interest of the mother. Of course the operation in this instance was a forlorn hope.

CASE 2. 1915. H. S., aged 26, ii-para, pregnant at term, entered the hospital suffering with very violent eclampsia which had been present for 17 hours, although she was not in labor. The convulsions continued, in spite of a classical cæsarean section, until her death 13 hours after entrance. Her first labor had been normal.

The pelvis was normal, the blood pressure was only 144–110 on admission, she was not in labor, the os was not dilated and the fetal head was floating. The urine was not sufficient for examination. The temperature was normal.

Like the former case, this one was almost hopeless at the start, yet called for some efforts on our part, which were unavailing.

CASE 3. 1918. G. B., aged 18, primipara, entered the hospital, after some hours of violent labor, with tetanic contractions of the uterus and threatened rupture. There was a marked retraction ring. The pelvis was of a moderate justo-minor type. The measurements were: interspinal, 23; intercristal, 25.5; intertrochanteric, 30; external conjugate, 17. A vaginal smear showed gonococci. After the operation she was transferred to Ward 43, the female venereal ward. The child weighed 7 pounds 8 ounces.

The postoperative course was very stormy, with much pain in the abdomen, much distention and with various râles in the lungs. The patient died 25 days after the operation, which was of the classical type.

The autopsy showed general peritonitis and gangrenous endometritis. Perhaps craniotomy at once would have been better treatment in spite of the justo-minor pelvis.

CASE 4. 1919. M. N., aged 25, primipara, entered suffering with impending eclampsia, and having a flat rachitic pelvis, with the following measurements: interspinal, 23; intercristal, 23; intertrochanteric, 30; external conjugate, 16. She had a very extensive ventral hernia, with very thin wall, consisting mostly of integument, the result of a former operation. The history was vague in regard to the period of gestation, but the X-rays taken by Dr. Blaine showed it to be between eight and nine months. She was kept in the hospital before operation for about 12 days while the probable period of gestation was being determined. The operation was the classical one with the addition of an operation on the ventral hernia and sterilization. A paralytic ileus resulted which caused the abdominal wall to be so distended that the wound ripped open on the third day after operation.

After the operation the patient ran a nearly afebrile course, and died apparently from shock, due to the rupture of the wound and the consequent emergency operation necessary to repair it. A criticism of this case might well include the delay of 11 days before operating.

CASE 5. In 1922 there were five deaths. The first one was E. W., aged 22, iv-para, height 4 feet 10 inches, weight 190 pounds, very obese, entered the hospital about 4 weeks before her expected time. She had a slightly flat pelvis: interspinal, 24; intercristal, 25.5; intertrochanteric, 40; external conjugate, 21; conjugata vera, 9. The history is silent on the former labors. After 40 hours' labor the head was still floating. One sterile vaginal examination was made. The classical cæsarean operation was performed under the handicap of a very thick abdominal wall. The patient had an almost afebrile course until the nineteenth day after operation when she got up during the night, wandered to an adjoining room with a tile floor, fell and was found a few seconds later, by attendants who heard her fall, dead on the floor. The autopsy showed a fractured cranium, also thromboses in the iliac veins and the vena cava. The baby weighed 8 pounds 2 ounces.

CASE 6. 1922. C. B., aged 35, i-para, had a moderately contracted justo-minor pelvis with no engagement after 24 hours. One sterile vaginal examination was made in the hospital. The pelvis measured: interspinal, 22; intercristal, 26.5; intertrochanteric, 30.5; external conjugate, 18.5. Cæsarean section seemed indicated because of the age of the patient, the apparent fair size of the baby, no engagement after 24 hours, and a breech presentation. The membranes had ruptured 24 hours before the operation, which was of the low cervical type. The only choice in treatment was between embryotomy with a high breech and cæsarean section.

The temperature was febrile from the second day, running from 100 to 105. The abdomen became greatly distended and the woman died 10 days after the operation. The autopsy confirmed the diagnosis of septic peritonitis from streptococcus hæmolyticus.

CASE 7. 1922. B. F., aged 32, ii-para, entered the hospital in the eighth month, suffering from a septic meningitis. The pelvis was of the justo-minor type and measured: interspinal, 21; intercristal, 23; external conjugate, 16.75. One sterile vaginal examination was made. The child weighed 5 pounds 14 ounces. The mother continued her high febrile course after the operation until she died on the second day.

This patient entered in coma, had severe earache a few days before, and showed the spinal fluid cloudy and under pressure. The autopsy confirmed the diagnosis of meningitis. The operation was of the classical type.

CASE 8. 1922. C. H., aged 30, ii-para, pregnant at term, gave a history of a former difficult labor lasting 3 days. An operation for appendicitis in 1911 was followed by peritonitis. There were two abdominal scars. During this pregnancy she had frequent severe headaches, dizziness, black spots before the eyes, with vomiting daily for the last 3 months. The urine contained casts and much albumin.

The operation was the classical cæsarean complicated by scars, adhesions, and presenting intestine. The separation of adhesions and freeing of the intestine was very difficult, because of the thorough matting together of the abdominal contents. A small rent was made in the intestine during the course of separation but was sutured as soon as possible. Abdominal drainage was employed.

A suppurating peritonitis and a fæcal fistula followed but without much fever. The temperature ran between 99 and 101, and for 12 days only. The patient finally died of exhaustion 26 days after the operation.

CASE 9. 1922. S. G., aged 27, primipara, pregnant at term, showed upon examination a very irregular flat pelvis. There was a marked right dorsal scoliosis, kyphosis from the sixth dorsal to the first lumbar vertebra, and below a compensatory lordosis. The sacrum was flat and short. The right leg was an inch shorter than the left. The fetal head was overriding. The pelvis measured: interspinal, 26.5; intercristal, 25.5; intertrochanteric, 31; external conjugate, 15.5; diagonal conjugate, 10. The child weighed only 4 pounds 14 ounces.

The patient had a temperature of 99.6 degrees on the second day after the operation and running between 99 and 107 for 8 days. The urine was negative on entrance but showed large amounts of albumin and casts after operation. The autopsy revealed acute mitral endocarditis with infarcts in the spleen, miliary abscesses in the kidneys and liver, besides many adhesions between the uterus and the abdominal wall. This case appears to have been an acute streptococcus infection following the operation. One antepartum sterile vaginal examination was made. The operation was of the low cervical type.

CASE 10. In 1923 there were 3 deaths. The first was E. R., aged 19, primipara, pregnant near term, who entered the hospital with hæmorrhage and other symptoms of placenta prævia. A sterile vaginal examination just before operation confirmed the diagnosis of placenta prævia marginalis. The pelvis was justo-minor of considerable degree, with the following measurements: interspinal, 20; intercristal, 23; external conjugate, 16; diagonal conjugate, 9 plus; true conjugate, 8 minus.

The classical operation was performed a short time after entrance. The patient appeared to be in good condition. Fever appeared about the second day after operation and rose to 104. Symptoms of lobar pneumonia appeared within a few days and ran a rapid course. The urine contained a moderate amount of albumin with hyaline and granular casts. Death occurred 19 days after the operation, which was not difficult and did not last unduly long. Perhaps the anæsthetic was to blame, although the ether was administered by one of our best anæsthetists.

CASE 11. 1923. B. D., aged 26, secundipara, entered the hospital after a hard labor of 36 hours' duration. The pelvis was adequate, measuring: interspinal, 24; intercristal, 30.5; intertrochanteric, 39. A sterile vaginal examination just before operation showed that there was a large exostosis at the promontory which much reduced the true conjugate diameter. A history of the first labor was not obtainable and no time was spent in trying, as the woman was apparently exhausted. She was operated upon by the classical method very soon after entrance. The urine taken by catheter during the preparation showed much albumin and many pus cells. The patient was in much shock at the end of the operation while sutures were being passed, and died while dressings were being applied.

CASE 12. 1923. M. McN., aged 19, primipara, pregnant at term, entered the hospital after a rather long labor under the care of a midwife, who had made one or more questionable vaginal examinations. The external measurements were: interspinal, 22; intercristal, 24; intertrochanteric, 31.5; external conjugate, 21.5. A sterile vaginal examination just before operation showed a prominent exostosis on the right iliac spine which reduced the diameter of the canal to the absolute indication. Just before operation the membranes ruptured.

The classical operation was done. Of course the placenta and membranes had to be brought through the cervix, through which the membranes had prolapsed at the time of rupture. Although this was done with the greatest possible care, it is likely that this factor weighed much in the development of a speedy peritonitis with temperature reaching nearly to 104 during the 7 days before the fatal ending. In this case embryotomy would have been even a greater risk than a cæsarean.

CASE 13. In 1924 there were 3 deaths. The first was E. G., aged 41, viii-para, pregnant 8 months, who entered with a history of obstruction of the bowels for 4 days. On account of her pregnancy she was sent to the obstetrical ward, but, because of the evident necessity for haste, one of the surgeons of the hospital, who happened to be present, kindly consented to operate. The classical cæsarean section was successfully and speedily done but the patient died of shock before the intestinal work could be begun.

CASE 14. 1924. L. W., aged 26, primipara, suffered from a pregnancy at term, complicated by numerous small fibroids. There had been brisk labor pains without any progress for 30 hours before the operation, which was started soon after the patient's admission. The pelvic measurements as recorded were: interspinal, 23; intercristal, 26; intertrochanteric, 31; external conjugate, 20. The history stated that the pelvis was generally contracted. This must have been correct, since the baby's measurements were: 10 pounds 15 ounces; length, 54 centimeters; bi-temporal, 9; sub-occipito-bregmatic, 12; occipito-frontal, 12.5; and occipito-mental, 14.

The Porro operation was done. The temperature ran from 99 to 103; the pulse became rapid, air hunger came on suddenly, and the woman died on the third day after operation. The autopsy revealed a large amount of blood from a severe intraperitoneal hæmorrhage.

CASE 15. 1924. M. R., aged 28, primipara, pregnant at term, entered with placenta prævia complicated by fibroids. The pelvis was adequate, with a diagonal conjugate of 12.25. There had been considerable hæmorrhage because of the low attachment of the placenta. The baby was dead. A Porro-cæsarean was performed. The mother died on the table, in spite of saline solutions given subcutaneously and blood transfusion. The X-ray had showed a calcified fibroid obstructing the fetal head.

CASE 16. 1925. T. F., aged 19, primipara, entered after a prolonged dry labor of 33 hours without progress. She had a moderately flat pelvis, measuring: interspinal, 22; intercristal, 24; intertrochanteric, 32; external conjugate, 20; conjugate diagonal, 9.5; bis-ischial, 7.5. The child, however, was not large. Two vaginal examinations had been made previously. The patient developed a high temperature which reached 105, with frequent chills. She died on the seventh day of acute gangrenous endometritis and acute generalized peritonitis. The operation was of the transverse cervical type.

There are 4 of our deaths which perhaps could not fairly be charged to the operation *per se* because of peculiar circumstances concerning the operations.

The death in 1914 in the case of the vaginal section is one of these. The patient entered in deep coma alternating with very severe convulsions. The heart was much damaged, the urine was loaded with albumin, casts, and

red cells. It was evident that the patient could not recover unless the uterus was emptied. The baby was of 6 months' gestation and labor had not begun. Vaginal section seemed to offer the best chance. Anything else would be tantamount to nothing. Other treatment, such as bleeding, sedatives, and morphine had been tried. She was marked for death when first seen on entrance.

The case of 1915 seems to have been equally hopeless. Severe convulsions had persisted for 17 hours, although she was not in labor. Perhaps the vaginal section or other form of accouchement forcé would have been better than the classical operation which was done. She also had treatment like that of the former case and like the former she resisted all treatment. The bladder contained almost no urine. She died 13 hours after entrace.

The third case of 1922 was that of a woman who entered in the eighth month, moribund with septic meningitis. The operation was practically an ante-mortem autopsy, done avowedly in the interest of the child only.

In the third case of 1924 the patient had had obstruction of the bowels for 4 days before coming in. She was in the eighth month of her eighth pregnancy. The direct indication was the intestinal condition for which the cæsarean section was necessary before the obstruction could be treated surgically. I think that the most enthusiastic advocate of a low cæsarean operation would have preferred the classical in this instance. The patient succumbed to shock before the cause of her condition could be attacked.

If we should be allowed these 4 alibis our percentage of deaths on the basis of 166 cases would be 7 per cent. On the basis of 154 cases our percentage would be 8 per cent.

DEATHS BY TYPE OF OPERATION

There were 10 deaths with the classical operation, or 11.5 per cent; 2 by the low cervical, or 5.7 per cent; 1 by the transverse cervical, or 7 per cent; 3 by both cervicals, or 6.2 per cent; no deaths with the longitudinal fundal; 2 with the Porro, or 33.3 per cent; 1 by the vaginal, or 100 per cent, as follows:

Operation	Cases	Per cent
Classical	10	11.5
Low cervical	2	5.7
Transverse cervical	1	7.7
Both cervical	3	6.2
Longitudinal fundal	0	0
Porro	1	33.3
Vaginal	1	100

TYPES OF OPERATION

The classical operation of Saenger was the one most frequently used. Eighty-seven such operations are included in the 158 cases belonging to this series. Six patients were operated upon by the Porro method. One vaginal cæsarean section was done. The low cervical operation of Kroenig was done by two of us. These operations numbered 48. One operator employed the low incision through the abdominal wall with the longitudinal incision through the lower segment and cervix; the other made a transverse opening through the cervical muscles, usually with the fingers. The former method I have termed the low cervical and the latter the transverse cervical. There have been 35 low cervical and 13 transverse cæsarean sections.

Another type of operation has been done by two of us for a few years. This I will call the longitudinal fundal cæsarean, of which there were 16 cases. The incision, long enough to allow dislocation of the uterus, is made in the abdominal wall in the median line about half above and half below the navel. After the uterus has been everted the abdominal wound is temporarily held together by means of one or two vulsella and the base of the uterus is lightly packed with gauze. Thus the spill is well controlled and we rarely have any fluids leaking into the belly. The uterine incision is made longitudinally in the median line of the fundus of the uterus, large enough to permit delivery of the baby and extending equally fore and aft. By tilting the uterus the spill can be directed away from the wound. One advantage is that the uterine wound is as far as possible away from the usual source of infection, which is almost always via the genital canal. It is the ideal method for the case of placenta prævia in which the cæsarean operation may sometimes be indicated.

CLINICAL SURGERY

FROM THE CLINIC OF THE SANATORIO VALDES

SURGICAL TREATMENT OF ABSCESSES OF THE LIVER

By ULISES VALDES, F.A.C.S., Mexico City, Mexico

LARGE liver abscesses, usually of amœbic origin, are treated by drainage into the lowest part, as are abscesses in almost any other region. If the drainage is ample and is placed in the correct position, cicatrization, even in the largest abscesses, takes place rapidly, in from 3 to 4 weeks, but if the drainage tube is placed so that it is too straight or is over the base of the abscess, the period of healing is prolonged to one or more months, necessitating among other inconveniences, a longer stay in the hospital and a greater expense and a longer period of incapacity for work.

Abscesses of the liver which rupture spontaneously into the stomach or intestine generally heal readily because the position of the opening is favorable for cicatrization. On the other hand, abscesses which rupture into the bronchi never heal spontaneously because the opening is high, and in such cases it is necessary to drain the abscess at its base.

Drainage of these abscesses is accomplished by either of two methods: (1) by arranging an ample canalization in the lowermost part of the abscess, or (2) by not infecting the pleural and peritoneal cavities which are frequently encountered in operations performed at the opportune moment.[1]

TECHNIQUE

We do not make a puncture for diagnostic purposes alone until we are prepared to proceed with the operation, because if the needle enters a pus pocket, the entire course of the needle is apt to become infected as the needle is withdrawn. Puncture is done only at the time of operation, when the patient has been anæsthetized. An

[1] There are other methods which differ from those named here. See Les hepatites dysenteriques et leur traitement. A. Valassopoulo y P. Petrides, 1924.

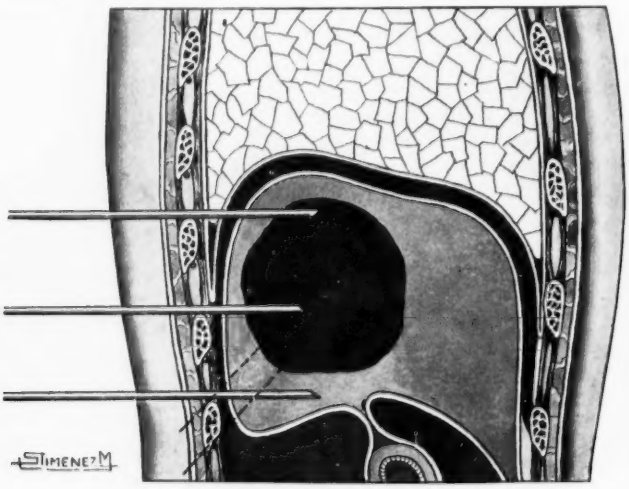


Fig. 1. A schematic drawing showing the site of puncture. The interrupted line shows the position of the drainage tube.

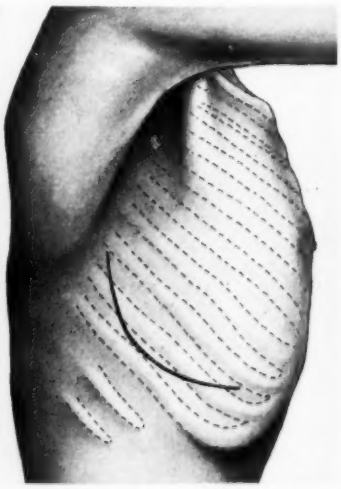


Fig. 2. The skin incision, measuring 12 to 15 centimeters in length, is curved downward.

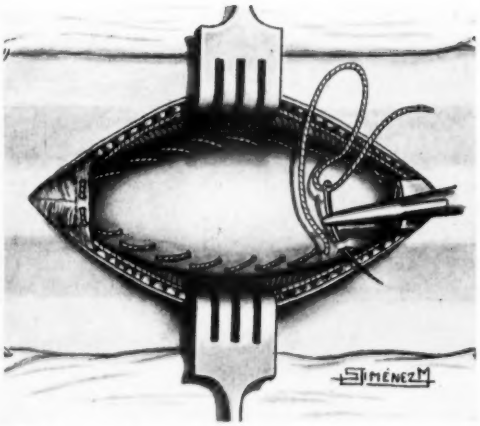


Fig. 3. Catgut suture closing the pleural cavity and covering the ends of the ribs.

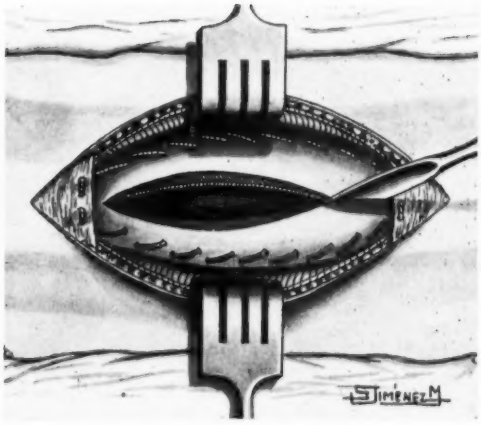


Fig. 4. Drawing showing the incision of the pleura and diaphragm.

Fig. 5. Suture which fixes the liver and diaphragm and closes the abdominal cavity.

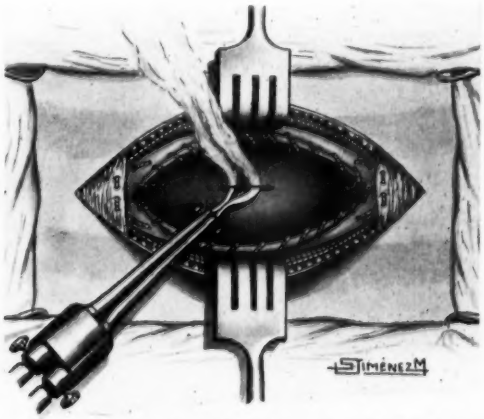


Fig. 6. Showing the method of puncture of the abscess with the galvanocautery.

Surgical Treatment of Abscesses of the Liver.—Ulises Valdes.

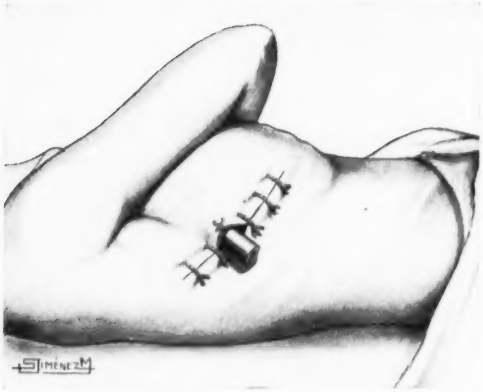


Fig. 7. Appearance of wound at end of operation. Note the oblique direction of the tube.

attempt is made to locate the purulent collection, especially the base. To this end, a puncture is made over the point of maximal pain, presumably over the center of the abscess, and with another needle, a second puncture is made some centimeters deeper, according to the assumed size of the abscess. If a pus pocket is entered and pus is extracted, the process is repeated, the needle being changed each time, until the syringe when withdrawn contains no pus (Fig. 1). This will be the point of incision, and the rib immediately above this point is the rib which is to be resected. If the fundus of the abscess is found to be below the costal margin, the operation will be entirely abdominal.

Taking the point of the last puncture as a center, a curved incision 12 to 15 centimeters is made, so that the two ends extend to the lower edge of the rib above the one being resected and the lowest point of the incision is at the upper edge of the rib immediately below the one being resected (Fig. 2).

The rib is resected subperiosteally the entire length of the incision, care being taken to preserve the periosteum so that the cut ends of the rib are covered and osteomyelitis is thus avoided. Osteomyelitis is a frequent complication when pus is allowed to come in contact with the cut ends of the ribs, fistulæ forming which require another operation.

After the rib is resected and before the pleural cavity is opened, the edges of the incision are drawn back with two retractors, and an oval line of catgut sutures including the pleural walls and the ends of the resected rib, is made (Fig. 3).

The incision is made through the pleura and the diaphragm into the peritoneal cavity to expose the surface of the liver (Fig. 4). Then a second row of sutures is made, concentric with the first, to include the edges of the wound in the diaphragm and the surface of the liver (Fig. 5). The surface of the liver is thus fixed and exposed. In this manner the pleural and peritoneal cavities are protected from drainage of pus. If the liver has become so damaged by the infectious process that the sutures become loosened, gauze is packed between the liver and the diaphragm, and allowed to remain for 3 or 4 days. In this manner adhesions are produced which again effect a separation of the abscess from the serous cavities.

With gauze moistened in serum, all bleeding surfaces are protected, leaving exposed only the surface at which the red hot electric cautery is to enter.

As the incision has been placed in a plane far below the abscess, a new puncture must be made to locate the abscess, the needle being followed by the electrocautery (Fig. 6), or if preferred, by the point of a closed arterial forceps so that the pus gains slow exit. By opening the forceps the wound in the liver is enlarged to an inch or an inch and a half, and a large tube (a centimeter or ¾ centimeter in diameter) is inserted and fixed at the edges of the wound (Fig. 7).

The wound is closed in layers, with the drainage tube fixed in place. The wound is dressed once or twice daily according to the amount of discharge. The day after operation the patient is removed to the open air in a wheel chair. In cases of amœbic abscess, daily injections of emetin will favor cicatrization.

FROM THE DIVISION OF SURGERY, MAYO CLINIC

CHOLECYSTGASTROSTOMY

BY WALTMAN WALTERS, M.D., ROCHESTER, MINNESOTA

AN anastomosis between the gall bladder and the stomach is made to allow the passage of bile from the gall bladder into the stomach, when the former is distended as a result of obstruction in the distal portion of the common bile duct either from stricture or pancreatic obstruction. To insure adequate function, the obstruction must be entirely distal to the entrance of the cystic duct into the common duct. In two of every three cases, the lower portion (1.5 to 2.5 centimeters) of the common duct passes through the substance of the pancreas, and in these cases pancreatitis or carcinoma may cause compression of the pancreatic portion of the common bile duct sufficient to produce painless and increasing obstructive jaundice. Cholecystgastrostomy short-circuits the bile into the intestinal tract, thus relieving the biliary obstruction, the jaundice subsides and with it the persistent pruritus so annoying in such cases. If the obstruction is due to stricture or pancreatitis, the patient's recovery will be permanent. The risk of the operation is from the oozing from jaundiced tissues, which can be prevented by intravenous injections of calcium chloride; from bleeding into the lumen of the anastomosed structures from the cut ends of enlarged veins in the wall of the gall bladder, which can be prevented by a hæmostatic inverting stitch of the button-hole locking type; and from leakage in the suture line as a result of tension of the stomach when distended with fluid.

The hæmorrhagic tendency of jaundiced tissues can be controlled, in most instances, by intravenous injections of 5 cubic centimeters of a 10 per cent solution of calcium chloride given daily for 3 days prior to operation. If this does not reduce the coagulation time of the blood to within normal limits, it may be accomplished by transfusing blood. Operation should be postponed until the coagulation time of the venous blood is less than 6 minutes. The toxæmia is associated with the accumulation of non-protein nitrogen in the blood and tissues of the body and a lack of available glycogen in the diseased liver. To compensate for this, abundant fluid to induce diuresis is indicated, by mouth usually, but for patients who have difficulty in taking fluid by mouth, intravenous injections of physiological sodium chloride solution, and 10 per cent glucose solution are also recommended. The diet should consist of an abundance of carbohydrates. This method of pre-operative preparation of patients with obstructive jaundice was begun at the Mayo Clinic 4 years ago and has been used as a routine since then. As a result the incidence of post-operative hæmorrhage in cases of obstructive jaundice, when biliary obstruction has been

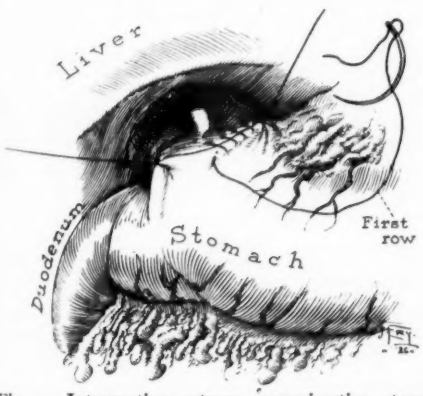


Fig. 1. Interrupting sutures approximating stomach and gall bladder and first row of continuous Lembert suture approximating peritoneal coats of stomach and gall bladder.

Fig. 2. Incision through peritoneal and muscular coats with union and approximation by continuous suture.

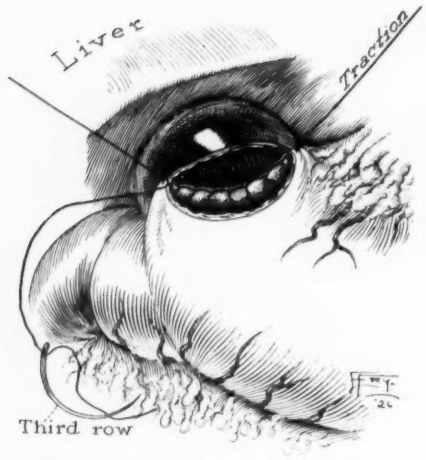


Fig. 3. Lumen of stomach and duodenum and approximation of mucous membrane by a locking suture, a continuation of that used in Figure 2.

adequately relieved at operation, has been reduced to less than 2 per cent.

The anastomosis is made between the gall bladder and the portion of the upper intestinal tract which lies in closest proximity and which can be applied to it with the least amount of tension, usually the stomach or duodenum. Should the duodenum be adherent to the gall bladder, anastomosis between these two is easily performed. Anastomosis between the gall bladder and the stomach can be easily and safely accomplished because of the better blood supply and the greater thickness of the gastric wall, which allows three rows of sutures to be used, as in gastro-enterostomy. If the gall bladder is anastomosed to the stomach a convenient point for the attachment is about 7.5 centimeters above the pylorus near the lesser curvature.

The operation is essentially that of any lateral anastomosis in which three rows of sutures are used. A stitch locking from the lumen inverts the cut edges of the gall bladder and stomach, approximates their peritoneal surfaces, and at the same time prevents bleeding into the lumen of the gall bladder or intestine from the cut ends of the enlarged veins in the wall of the gall bladder (Fig. 4). The operation can be accomplished with or without the use of the Doyen clamps, although preferably without, because of the possible injury to the walls of the gall bladder from compression by the clamps. Without the clamps, a suction pump can be employed to empty the stomach and gall bladder of their contents and, when placed at the dependent angle of the anastomosis, assists in keeping the field of operation dry. Before the stomach and gall bladder are opened, gauze packs are inserted to prevent leakage during the operation into the left and right subhepatic fossa and the general peritoneal cavity. The contents of the distended gall bladder are removed through a trocar introduced into the gall bladder at a point which, when extended, can be included in the anastomosis. The gall bladder and stomach or the gall bladder and duodenum are approximated by two interrupted sutures at points just beyond what are to be the extremities of the anastomosis (Fig. 1). In this way the anastomosis can be accomplished as easily as though clamps were approximating the two viscera. After the first row of sutures has been inserted, incision is made through the peritoneum and muscle of both stomach and gall bladder, which are approximated by a second continuous suture (Fig. 2). The mucous membrane of both viscera is opened and the edges approximated by a continuous suture backward, of the locking type (Fig. 3), joining the submucosa and mucosa. This controls the bleeding from the vessels in the submucosa in the posterior line of the anastomosis. The same stitch is continued across the anterior edge of the anastomosis, the stitch being locked from the inside surfaces of the gall bladder and stomach. This not only approximates their peritoneal surfaces, but more important, controls the bleeding from the large veins in the walls of the distended gall bladder (Fig. 4). The first row of sutures begun posteriorly is continued forward, after the method of Lembert, slightly inverting the anterior suture line. A portion of the gastrocolic omentum is used as a patch to cover the posterior line of anastomosis, while the gastrohepatic omentum is similarly applied to cover the anterior line (Fig. 5). Tension on the anastomosed parts is prevented by attaching a portion of the anterior wall of the stomach proximal to the anastomosis to the falciform ligament of the liver by a few interrupted catgut sutures, thus keeping it to the right of the spine, a point emphasized by W. J. Mayo in Billroth I resections. Two Penrose drains, extending from the ends of the anastomosed area through the abdominal wall, are used as a precautionary measure, in case there should be any leakage of bile.

A stomach tube should be passed if there are any signs of gastric retention, as evidenced by hiccup, a feeling of fulness in the epigastrium,

Fig. 4. Locking suture uniting anterior walls, suture locking from the inside.

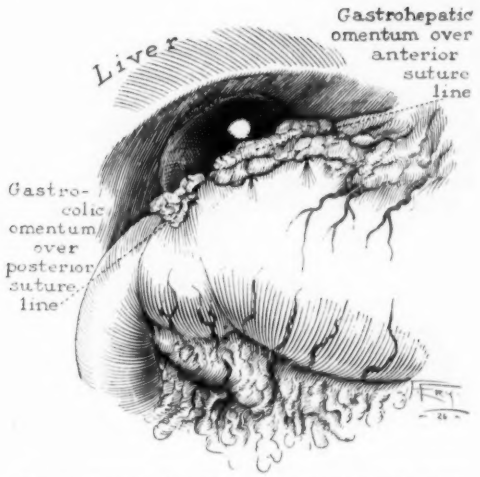


Fig. 5. Suture of portion of gastrocolic and gastrohepatic omentum, protecting suture line of the anastomosis.

or an increase in pulse rate. Gastric retention drags the stomach to the left of the spine and places great tension on the line of anastomosis, which must be prevented. Fluid is supplied by proctoclysis and hypodermoclysis. Neither fluid nor nourishment should be given by mouth for 3 days, in order to allow complete healing at the point of anastomosis.

SUMMARY

Cholecystgastrostomy, successfully performed, establishes a path of continuity between the intestinal tract and the biliary tract if there is obstruction distal to the point of entrance of the cystic duct. Besides the usual precautions necessary in any abdominal operation, the prevention of postoperative hæmorrhage and the prevention of tension at the line of anastomosis in these cases are of primary importance. The former is accomplished by controlling the oozing from tissue by pre-operative intravenous injections of solutions of calcium chloride and preventing the bleeding into the lumen of the intestine and gall bladder from the large veins in the wall of the distended gall bladder by means of an accurately placed hæmostatic suture. Tension on the suture line of the anastomosis is prevented by attaching the portion of stomach proximal to the anastomosis to the falciform ligament of the liver by interrupted catgut sutures keeping the pylorus to the right of the spine.

FROM THE SURGICAL CLINIC, ST. JOSEPH'S INFIRMARY

THE TECHNIQUE OF SUSPENSION OF THE UTERUS

By IRVIN ABELL, M.D., Louisville, Kentucky

THE preparation of the patient for operation for suspension of the uterus conforms to that usually employed for abdominal operations: cleansing and shaving of the abdomen on the day before operation with the application of a 2 per cent tincture of iodine to the field of operation on the morning of the day of operation and again when the patient is on the operating table.

The patient is placed in the Trendelenburg position. A four inch midline suprapubic incision is used (Fig. 1). Guy sutures of catgut are placed through or under each round ligament midway between their attachment at the cornua of uterus and their exit through the internal abdominal rings, and each suture is held by an artery forceps (Fig. 2). The sheath of the rectus is opened on each side in the midline incision and by blunt dissection the rectus abdominis gently separated from the under surface of the abdominal fascia (Fig. 2a).

A blunt pointed, curved artery forceps is passed out under the fascia, above the rectus muscle,

Fig. 2. Guy sutures.

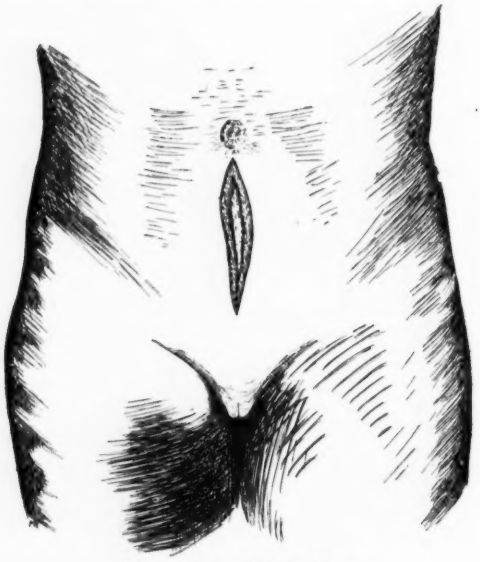


Fig. 1. Suprapubic incision.

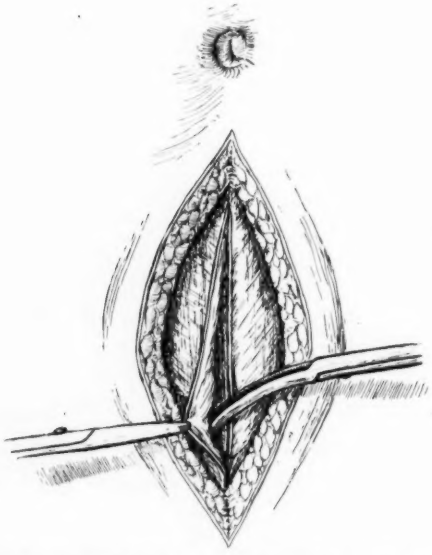


Fig. 2a. Sheath of the rectus opened and rectus abdominis separated from under surface of abdominal fascia.

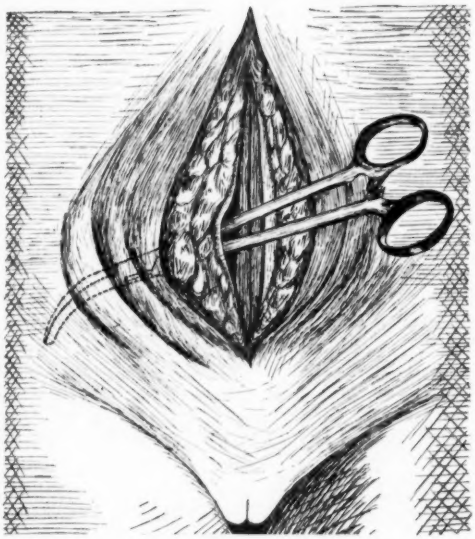


Fig. 3. The blunt pointed, curved artery forceps passed out under the rectus muscle, etc.

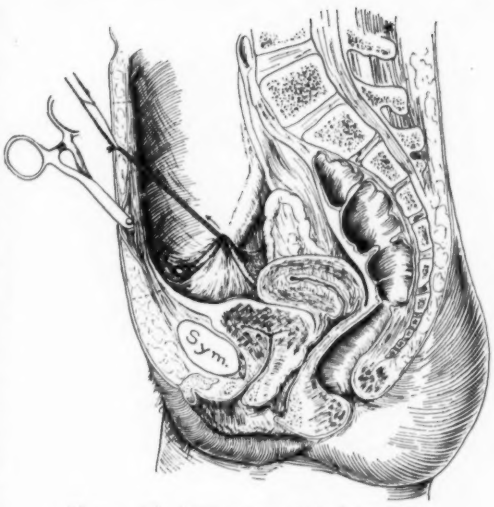


Fig. 3a. The inner aspect of the internal ring.

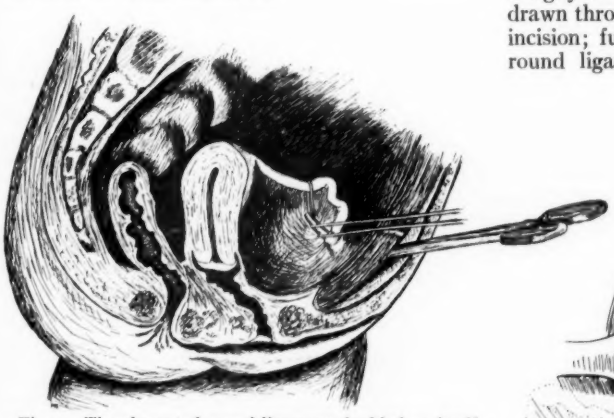


Fig. 4. The elongated round ligament doubled on itself brought through the internal ring over the upper surface of the rectus.

below the posterior termination of the sheath of the rectus to the outer aspect of the internal ring: with the abdominal wall of the corresponding side elevated, the inner aspect of the internal ring is made prominent by traction on the guy suture in the round ligament and the artery forceps is forced in through the internal ring under the peritoneum and on the upper surface of the round ligament, penetrating the peritoneum when well within the limits of the parietal peritoneum. The blades of the artery forceps are separated, the guy suture in the round ligament grasped and drawn through the internal ring into the midline incision; further traction brings the elongated round ligament doubled on itself through the

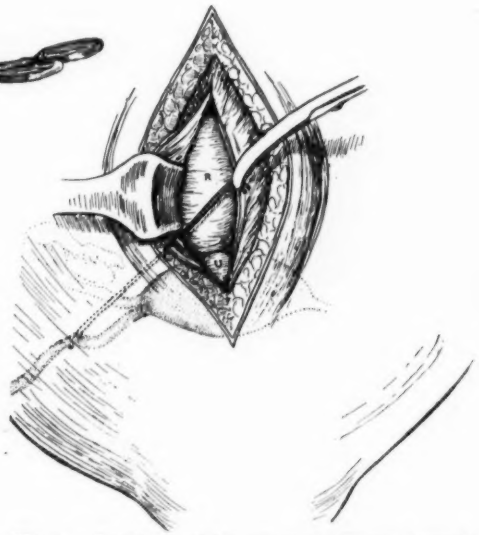


Fig. 4a. Showing position of round ligament beneath fascia.

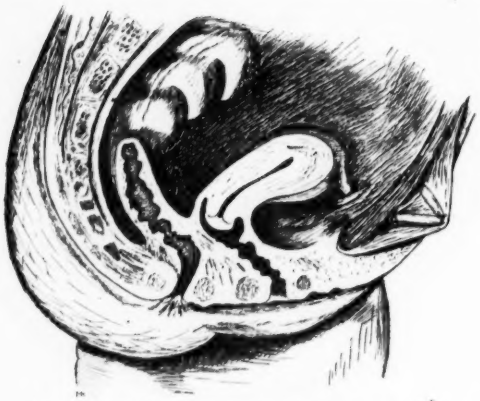


Fig. 5. Double fold of round ligament spread out in shape of triangle.

internal ring over the upper surface of the rectus and along the under surface of the fascia to the midline incision (Figs. 3, 3a, 4, and 4a).

The double fold of round ligament is spread out in the shape of a triangle and anchored to the under surface of the fascia with three catgut sutures, the apex at the cut edge of the fascia in the midline incision, the base looking outward toward the outer border of the rectus (Figs. 5, 5a, and 5b). The same steps are carried out with opposite round ligament. The midline incision is closed in tiers, the apex of each round ligament being sewed together as the fascia is closed (Fig. 6). No. 1 chromic catgut is used to suture the round ligament; No. 1 or No. 2 chromic catgut for the peritoneum and fascia; dermal sutures are used for skin or stay sutures of silkworm-gut, if

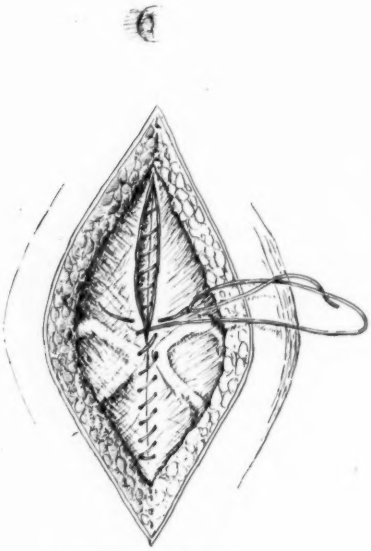


Fig. 6. Manner of closure.

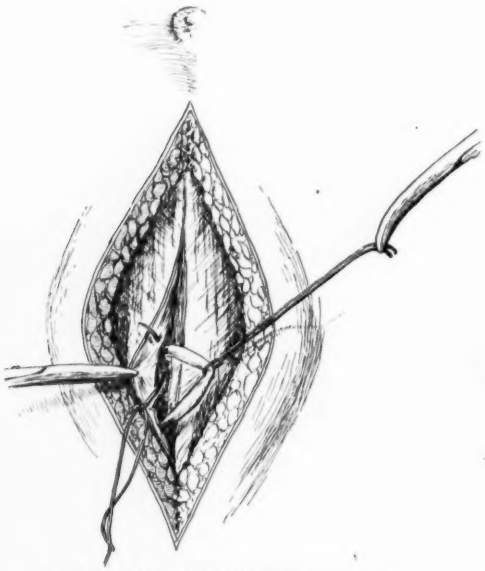


Fig. 5a. The fold anchored with three catgut sutures.

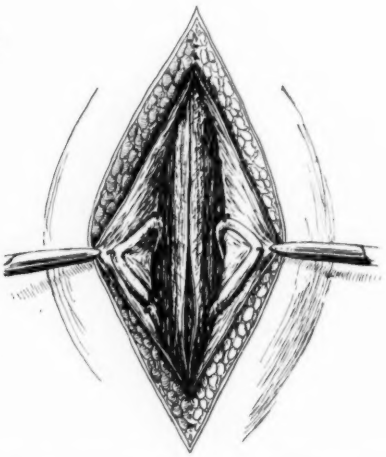


Fig. 5b. Both round ligaments sutured in position.

desired. Care should be exercised to avoid tying the round ligament sutures too tightly; otherwise necrosis will result and permit of the round ligament being drawn back unto the abdomen.

Postoperative care is the same as that in a case of an ordinary closed abdominal section, with rest in bed for 2 weeks following operation and the avoidance of severe physical exertion for a period of 6 weeks thereafter.

ADVANTAGES

The advantages of this operation are:

1. A certain amount of broad ligament tissue is pulled up and anchored with the round ligament to the under surface of the oblique fascia, thereby making the suspension a strong one.

2. All suturing of ligament is done outside the peritoneal cavity, which eliminates factors favoring peritoneal adhesions.

3. The dimensions of the pelvic cavity are in no wise altered.

4. The possibility of obstruction due to the anchorage of ligaments in abnormal situations is obviated.

5. Long experience has demonstrated that it does not interfere with subsequent pregnancies.

6. Relapse of the displacement is but infrequently seen.

TECHNIQUE OF HYSTERECTOMY[1]

By F. G. DuBOSE, M.D., F.A.C.S., Selma, Alabama
Vaughan Memorial Hospital

COMPLETE hysterectomy by the method I shall describe is a safer operation than subtotal hysterectomy.

The median aponeurotic raphé between the inner margins of the levator ani muscle is the beam supporting the pelvic floor. The cervix uteri is not the keystone of the pelvic arch. The cervix is tumor bearing tissue, and should be removed along with the neoplasm and uterus. Focal infections from the diseased cervix and its glands do occur; not rarely, as is claimed. Supravaginal amputation of the uterus is not as safe as a complete hysterectomy. If accidents follow the complete operation, they are the result of faulty technique. Six vesicovaginal fistulæ following hysterectomy were admitted to the Vaughan Memorial Hospital for operation during 1922 and 1923. No two were from the same surgeon, and three states were represented. My associate, Dr. D. H. Doherty, observed that we had escaped this distressing accident because of the free mobilization of the bladder forward, off both the cervix and anterior vaginal fornix; that the utilization of a fascial flap dissected off this cervical and vaginal area for closing the uterovaginal aperture in the pelvic floor had also prevented ptosis or prolapse of the vagina or of the remaining pelvic viscera; that in his search of the literature he failed to find any description of similar technique, which, in our hands, had given a degree of safety and satisfaction worth while to be made known. The tissue we had mistaken for fascia was a distinct muscle, and as such had escaped description.

ANATOMY

The structure, to which attention is called, in the female is the prototype of the levator prostatæ in the male. It has either escaped the attention of the anatomist, or it has been dismissed with the terse description that the anterior fibers of the levator ani muscle descend upon the sides of the vagina. (In the male, the anterior fibers from the levator ani muscle descend upon the sides of the prostate gland, and unite beneath it with the same muscle of the opposite side, supporting the prostate as a muscular sling.) Some anatomists describe it as a distinct muscle under the name of the levator prostatæ. Careful dissection in the female will demonstrate the same arrangement of muscle fiber fusing with its fellow of the opposite side over the upper end of the vagina and the cervix uteri, forming a sling for the cervix uteri on its anterior or under surface when it is normally anteverted. Furthermore, these fibers are as distinct on the surface of the cervix in the female as on the prostate in the male. This muscle arises from the os pubis, with the puborectalis, and follows its course backward and internal to it along the sides of the vagina, converging over the anterior vaginal fornix and anterior surface of the cervix, is inserted into the anterior surface of the cervix at the isthmus, and fuses into the median aponeurotic raphé with the fibers of the same muscle of the opposite side. This median raphé is a strong fibrous or aponeurotic band, extending throughout the midline portion of the uterovesical attachment. On either side the connection between the uterus and the bladder is of loose areolar tissue, and easily separated by blunt dissection in the lines of cleavage. Not so with the median attachment, which is dense and firmly adherent, holding the base of the bladder in a longitudinal line firmly attached to the cervix uteri, which portion is separated with difficulty by blunt dissection. In a hysterectomy it is usually cut with scissors. This fibrous band of attachment between the bladder and uterus begins approximately 1 centimeter below the isthmus, portiosupravaginalis, and extends downward and below on the vagina at its reflection on the cervix and between the vaginovesical attachment.

SURGICAL ANATOMY

After the uterovesical plica of peritoneum is incised, and blunt dissection of the bladder from the cervix uteri is begun, it is found that lateral to the midline the dissection is easy; the lines of cleavage being loose. In the midline, the fibrous connection is dense and closely adherent between the bladder and the cervix uteri. So difficult is blunt dissection in this area that frequently it becomes necessary to incise this raphé. As a matter of fact, it is always better after the dissection is done bilaterally to lift up this midline and cut the adherent tissue with scissors. As soon as this is done, the bladder is pushed forward readily beyond the vaginocervical junction. An incision is made with the knife 2 millimeters in depth, and a half centimeter below (which

[1]Read before the Southern Surgical Association, Louisville, Kentucky, December, 1925.

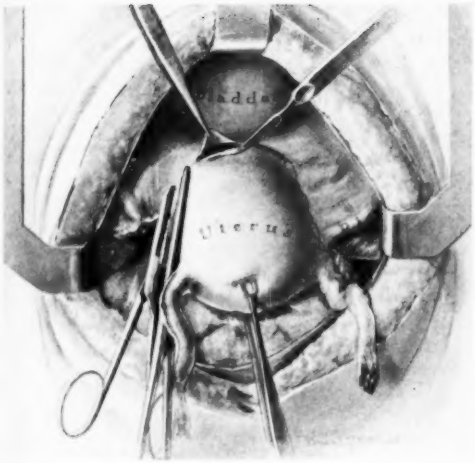


Fig. 1.

point is immediately below the isthmus) the cut edge of the peritoneum, and carried transversely across the cervix.

From this point in the incision, blunt dissection will push downward and forward a second layer of tissue off of the anterior surface of the cervix, and to a point on the anterior vaginal wall from 1 to 2 centimeters below its reflection on the cervix. If this band of tissue is lifted up, and spread out over the handle of a knife, examination will prove it to be muscular fibers which extend into and fuse with the levator ani muscle; they are in fact its anterior fibers and form in the female the same sort of a sling for additional support of the cervix uteri that they do in the male for the prostate gland (3).

ANATOMICAL RÉSUMÉ OF THE PELVIC DIAPHRAGM

Muscles	Fascia
1. Anteroposteriorly Levator ani Coccygeus Pyriformis	1. Sheaths of obturator internus, pyriformis, and pelvic diaphragm
2. Laterally Obturator internus.	2. The fascia associated with the pelvic viscera

LEVATOR ANI

Anterior portion, called (pubo-coccygeus) (pubo-rectalis) because of separate nerve supply, the inferior hæmorrhoidal branches of pudic nerve.

Posterior portion called (ilio-coccgyeus) because of separate nerve supply, anococcygeal nerve.

Origin: From pubic ramus, spine of ischium and intervening obturator fascia.

Course: Downward and backward to midline of pelvic floor.

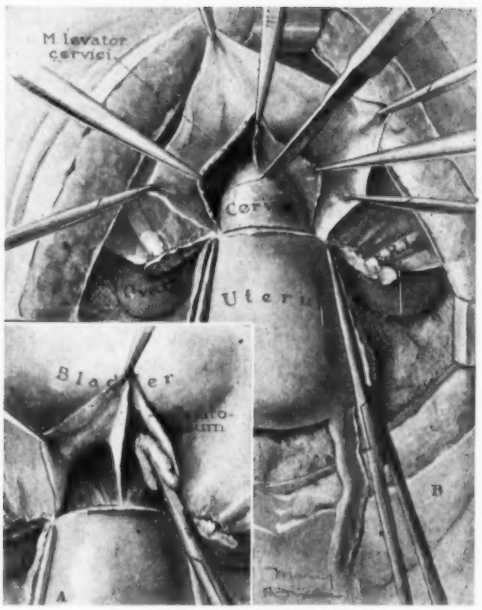


Fig. 2.

Insertion: Into last two segments of coccyx, the anococcygeal raphé. The middle fibers into the side of rectum blending with the sphincter fibers. The anterior fibers descend upon the side of the prostate in the male and the cervix uteri in the female, and unite underneath with the muscle of opposite side, also joining the fibers of the sphincter externus and the transversus perinæi at the central tendinous line of perineum. In this manner it forms a sling for support of cervix or prostate; this relation has caused these fibers to be called respectively levator cervicis uteri and levator prostatæ.

TECHNIQUE

A lower midline incision is made. Self-retaining retractors are put in place. Vulsellum forceps are inserted into the fundus of the uterus. The uterus is pulled up into the operative field. The intestines are carefully packed off with gauze. The right fallopian tube is caught with forceps and held up. A Reverdin needle is inserted underneath the tube at the cornu of the uterus. A loop is made in the margin of the tubal ligament. The ligature is tied, and the tube is cut loose beyond the ligature. The needle is passed in the broad ligament to the inner side of the ovarian ligament, emerging anteriorly underneath the round ligament. It is looped over the free border of the broad ligament and tied. A rat tooth clamp is applied close to the uterus, and the tissue

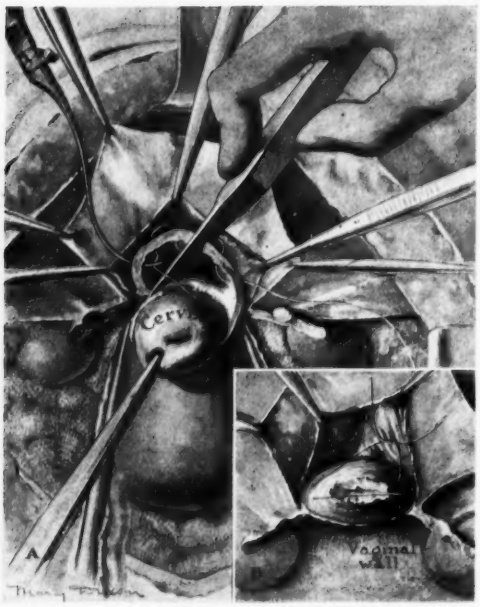


Fig. 3.

between the ligature and clamp is cut. A second ligature is passed through the broad ligament below the first small loop on the free border and tied. A clamp is placed close to the uterus, and the tissue between this ligature and the clamp is cut. A similar procedure is done on the left side, step by step (makes a figure of 8 with one large and one small loop). A small loop prevents the ligature from slipping. The lower part of the ovarian ligament is on a level posteriorly with the lower edge of the round ligament anteriorly, so that a suture passed from behind forward comes out immediately underneath the insertion of the round ligament, and completely ties off the ovarian artery, or blood supply, of the upper segment of the uterus. As soon as these two ligatures are placed, one on the right and one on the left, and the tissue between the ligatures in the broad ligament and clamp is incised, the uterus is so loosened that it can be drawn up into the operative field. The two lateral incisions are carried down to the reflection of the peritoneum from the bladder to the uterus on each side.

The uterovesical fold is incised transversely through the peritoneum. The peritoneal edge of the uterovesical fold is caught with a forceps, and easily dissected by the handle of the knife, or gauze covered finger, from the anterior uterine and cervical wall, or surface, except in the middle in front. The median raphé being firmly and rather densely connected is dissected free with a knife or scissors for a distance of an inch or an inch and a half. The bladder is thus easily separated from its cervical attachment, and pushed forward. An incision is made with the knife 2 millimeters in depth and a half centimeter below (which point is immediately below the isthmus) the cut edge of the peritoneum, and carried transversely across the cervix. From this point blunt dissection will push downward and forward a second layer of tissue off of the anterior surface of the cervix, and to a point on the anterior vaginal wall from 1 to 2 centimeters below its reflection on the cervix. This is the levator cervicis muscle, which has been described. The uterine vessels are next ligated by passing the Reverdin needle posteriorly through the peritoneal covered broad ligament into this raw space, which has resulted from the dissection of the bladder and muscular sling from the cervix uteri. The needle is passed close to the cervix. A No. 2 chromic catgut ligature is placed here by the figure of 8 method described above. This is done on both sides, and the tissue between the cervix and the ligature incised. Clamping the uterine side of this area is unnecessary, as very little bleeding results. The uterus is drawn still further up more easily, because it is now held only by its insertion into the vaginal vault. This last ligature ties the uterine arteries and such branches of the uterine arteries as are not caught within this ligature, can be seen readily from this area. This allows the broad ligament to drop well away from the uterus on each side.

The uterus is now free except for its attachment at the cervix uteri to the vaginal vault. When the uterus is drawn up, the anterior vaginal wall at its reflection over the cervix is brought well into the operative field, and the glistening vaginal wall presents itself. This dissection, as described, frees the bladder very widely from the uterus and the method of ligaturing the broad ligament prevents the possibility of wounding or engaging the ureters in the ligatures. An incision is made posteriorly over the isthmus, connecting the lines of dissection with each other front and back. The peritoneum is peeled off the posterior wall of the cervix well over the vaginal reflection of the posterior vaginal fornix.

The anterior vaginal wall, which is easily differentiated on account of its white and glistening appearance, is caught close to its attachment to the cervix by two rat tooth forceps, one just above the other, and in the space between the

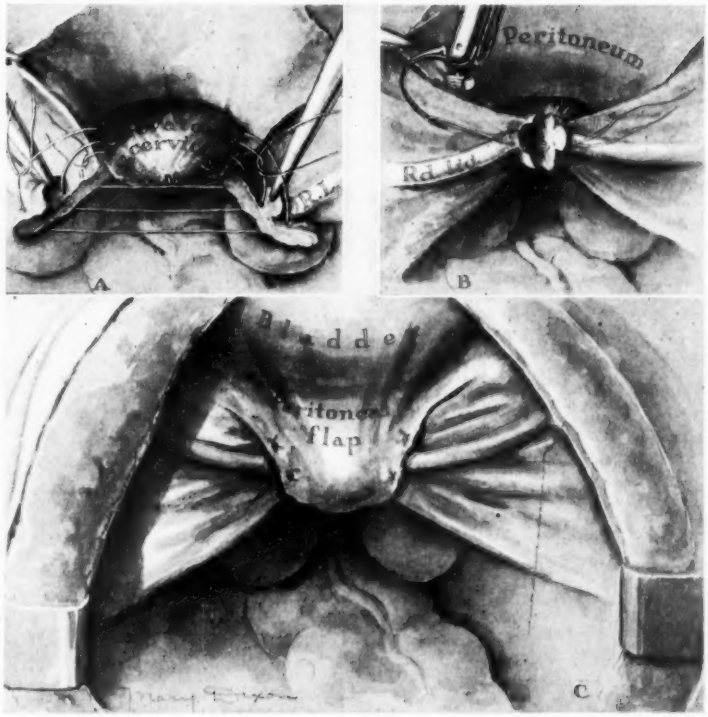


Fig. 4.

forceps the anterior vaginal fornix is incised and the vagina opened. The incision with either knife or scissors is carried around the cervix, to separate the vagina from it, care being taken to trim close to the cervix. As the vaginal wall is cut from, and close to, the cervix, it is caught at intervals with forceps, which act as hæmostats as well as exert traction, and prevent the vagina from prolapsing into the pelvic floor as soon as its attachment to the cervix has been completely severed. Thus the upper end of the vagina is wide open. It is disinfected either by tincture of iodine or mercurochrome solution, and then sutured.

The first sutures in the vaginal wall approximate only vaginal tissue, and are interrupted figure of 8 sutures, running from right to left, or across the upper end of the vagina laterally. In this, utmost care is used to catch the mucosa, otherwise bleeding from vaginal vessels may occur. This suture line having been completed, a mattress suture is placed in the vaginal wall opposite the base of the broad ligament on each side and tied. This inverts the sutured vaginal stump, and over this the levator cervicis is drawn and sutured laterally to the dome of the vagina, and posteriorly to the vaginal wall and overlying peritoneum. This is the step that restores the musculature of the pelvic floor, and is not very dissimilar to the flap operation for umbilical hernia.

The cut edges of the broad ligaments are approximated from below upward by a series of mattress sutures, the lower loop of the first traversing the vaginal dome underneath the levator cervicis muscle. The second suture is so introduced that the round ligaments are united; the third holds together the upper borders of the broad ligament. The edge of the reflected uterovesical plica of peritoneum is pulled forward over the broad ligaments covering the suture line, the raw margins inverted and held in place by interrupted sutures, completely peritonizing all the raw surfaces in the operative field.

A small rubber wick is always placed in the lower angle of the wound for drainage of the pelvic peritoneal cavity. The case lost in the total

hysterectomy group was the only one in the series in which the drain was not introduced. Hypodermoclysis of glucose, 15 per cent in normal saline, one liter introduced during operation, is a routine procedure. A plain hot water clyster is used after Clark's method. Infiltration of lower midline with one-fourth of 1 per cent apothesine solution permits incision of abdominal wall, while patient is being anæsthetized, and prevents shock from retraction on abdominal wall.

Nitrous oxide oxygen or ethylene oxygen is the usual general anæsthetic; rarely indeed ether, and then used only during the deeper pelvic part of operation.

The average operating time, including coincidental appendectomy, 40 minutes.

The abdomen is closed by the layer method, the edges of the parietal peritoneum being carefully everted.

This technique has no place in operations for cancer of the cervix. It is doubtful if hysterectomy is ever advisable in cancer of the cervix.

SUMMARY OF CASES

In our service at the Vaughan Memorial Hospital, in 5 years, from 1920 to 1924 inclusive (Table I), there were 108 hysterectomies done.

TABLE I.—SUMMARY OF HYSTERECTOMIES FROM 1920 TO 1924, INCLUSIVE

	Total abdominal hysterectomy	Subtotal vaginal hysterectomy	Vaginal hysterectomy	Total
Number	156	16	7	179
Recoveries	154	14	7	175
Deaths	2	2	0	4
Mortality	1.21 per cent	12.5 per cent	0	2.22 per cent
Cause of death	a. Pulmonary embolism. 1 week postoperative. b. Sepsis. Operative infections, not drained.	a. Septicæmia. Multiple abscesses. b. Puerperal sepsis.		

In the four years, from 1921 to 1924 inclusive, in Doctor Doherty's service at the Burwell Hospital, there were 71 hysterectomies. In both services, there were 163 total hysterectomies, 16 subtotal and 7 vaginal. In the entire number, there were four deaths. The sepsis case was the only case in the entire series, which was not drained at time of operation, and died of septic peritonitis. The one under subtotal hysterectomy, which died from septicæmia, had double pus tubes and had postoperative ileus. When the abdomen was reopened multiple abscesses were found in the pelvic cavity. The puerperal septicæmia case was not operated on until 48 hours after curetting the uterus, when hysterectomy was advised and refused by family and attending physician; consent being given when it was apparent that the patient was going to die.

COMMENTS

It is the purpose of this contribution to present a technique for hysterectomy on well defined anatomical lines, the dissections *in vivo*, identifying and isolating the structures in the operative field clarifies that area called parametrial tissue. The incidence of accidents to the ureters and bladder and the sequence of ptosis or prolapse of the pelvic viscera following hysterectomy will be either greatly lessened or avoided altogether. The statement that total hysterectomy is the operation of choice and safer than subtotal hysterectomy is true, provided that total hysterectomy is done along the plans outlined above, and not, surely not, according to the generally accepted present day technique. The element of individual skill is entirely ignored, for when a certain level among accredited surgeons is reached this factor is small indeed. To illustrate: of the cases here presented 97 were done by my associate, Dr. D. H. Doherty in the Burwell Infirmary, and to further confirm these apparently extravagant claims, there are reported in SURGERY, GYNECOLOGY AND OBSTETRICS, December, 1925, 162 subtotal hysterectomies with 9 deaths in uterine fibromyomata; 14 subtotal hysterectomies in chronic pelvic infections with 3 deaths. In this entire series, there were three ureteral fistulæ, and one vesicovaginal fistula.

We are convinced from our own experience that the operation of hysterectomy done by this method is safer than a subtotal hysterectomy.

The remote results: the recurrence of neoplasm, incidence of cancer in retained cervix, and an irritative or troublesome leucorrhœa, are avoided.

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IMPROVED OPERATION FOR CONGENITAL DEEP CUL-DE-SAC

By LEON GLASSMAN, M.D., Chicago
From the Gynecological Department of the Post-Graduate School and Hospital of Chicago

IN VIEW of the fact that cases of congenital deep cul-de-sac are not infrequent, it is unfortunate that even in the most skillful hands the prognosis is far from favorable, and it is a matter of chagrin to the operator to have his cases return to him repeatedly for repairs.

A congenital deep cul-de-sac is a condition in which the fibrous fatty tissue of the rectovaginal septum is partially or completely absent, and because of this lessened amount of packing between the anterior rectal and the posterior vaginal walls, the peritoneum during its further embryonal development fails to be pushed up from the contour of this channel to a normal level.

Diagnosis of congenital deep cul-de-sac, the true congenital posterior vaginal hernia, is described by my chief, Dr. Emil Ries[1], in his article, "A New Operation for Prolapse of Uterus," in which he states:

[1]Am. J. Obst., 1918, lxxvii, No. 5.

In the course of the abdominal part of prolapse operations I have repeatedly been able to demonstrate that the peritoneum may reach clear to the perineum, so that rectum and vagina are entirely separated. Also I have learned to diagnose these cases before operation. Of course, when the pouch of peritoneum contains bowel in the typical hernia fashion, it can be diagnosed, but I have never seen such an extensive case. I diagnose them now by introducing one finger into the rectum and taking hold of the protruding vaginal wall with the other hand. When now the vaginal wall is pulled upon, the rectal wall does not follow in these cases as it does in simple rectocele.

While this condition is now quite readily recognized, the treatment remains uncertain. Of all procedures, the most plausible theoretically is that of Ashton[2]:

After opening the abdomen the fundus of the uterus is seized with bullet forceps and pulled upward into the abdominal incision. A careful inspection is then made. . . . The sac is pulled out of the false canal, seized with long-bladed hæmostatic forceps, and tightly twisted upon itself. The sac is then ligated with a silk ligature (No. 12) and the redundant portion cut off. If the sac cannot be pulled out of the false canal on account of adhesions, the

[2]Textbook on the Practice of Gynecology. 6th ed., p. 266.

Fig. 1. A drawing showing the position of a normal cul-de-sac.

Fig. 2. A congenital deep cul-de-sac with peritoneum extending nearly to the perineum.

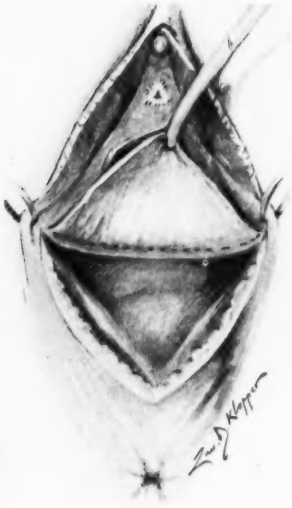


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

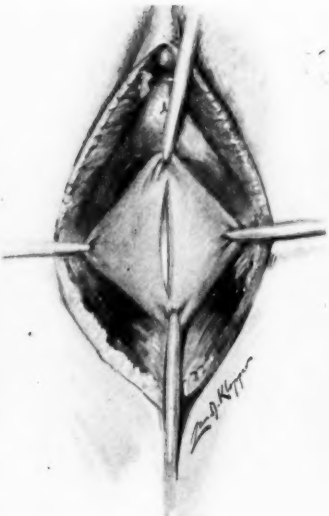


Fig. 7.

Fig. 8.

Fig. 3. Raised flap of posterior vaginal mucosa ready for excision. The sac is seen lying underneath.

Fig. 4. Complete excision of the flap of the posterior vaginal mucosa. The upper cut edge is held by a retractor. The peritoneal sac is seen adherent to the rectum.

Fig. 5. The lower pole of the peritoneal sac is being bluntly separated from its attachment to the rectum.

Fig. 6. Completely freed peritoneal sac held up by forceps.

Fig. 7. The freed peritoneal sac is held on tension by four forceps and incised at its lower pole. The exposed peritoneal surface is recognized by its shiny surface.

Fig. 8. The incised margin of the peritoneal sac is held with forceps, inverted and pushed up into the cul-de-sac.

Fig. 9. Abdominal view with the uterus held forward. The inverted peritoneal sac, previously incised through the vaginal route, is immediately noticed between uterus and rectum. The peritoneal sac drawn with forceps farther up into the peritoneal cavity. The peritoneal sac is obliterated with a suture ligature at its base at the approximate level of a normal cul-de-sac and will be cut off above the ligature as indicated by the dotted line.

Fig. 10. Cul-de-sac at the normal level with ligated inverted stump of peritoneal sac. The three fine catgut sutures between the vagina and the rectum for obliteration of the space between both.

opening should be closed with interrupted silk sutures (No. 7) at the normal level of Douglas's cul-de-sac.

But we have conclusively demonstrated that this method is not feasible. The peritoneum cannot be separated from its attachments and will not peel off so as to enable the operator to twist it upon itself in the described manner nor in fact in any manner whatsoever.

Aside from methods which must be abandoned because of their non-feasibility, we find that other procedures although obliterating the cul-de-sac at the time of operation, do not prevent the recurrence of the malformation. If we accept a congenital deep cul-de-sac as analogous to an inguinal hernia, we conclude that obliteration of the peritoneal sac is the primary step in its treatment. But this obliteration must be at a nearly normal level and be permanent.

In order to achieve these two considerations, namely, (1) the obliteration of the cul-de-sac at a nearly normal level, and (2) the permanence of this obliteration, I devised an operation. This operation requires both vaginal and abdominal work, thereby obtaining the great advantages of securing the peritoneal sac from below and of permitting the use of it as a safe guide in the abdominal work.

The vaginal operation consists of an incision of any shape on the posterior vaginal wall which will permit entrance into the deeper structures; the denudation of the vaginal mucosa; and the excision of the redundant portion of the mucosa. Underneath this mucosa and in front of the rectum, the peritoneal sac is found. The sac is bluntly dissected from its attachments up to the required level, which should be approximately 7.5 centimeters from the perineum. The freed peritoneal sac is picked up with forceps and may be inverted without being incised. The incising of the sac at this time, however, offers several advantages:

1. Demonstration of entrance into the free peritoneal cavity. (The exposed peritoneal surface is recognized by its shiny appearance.)
2. Digital exploration of the sac.
3. Easier handling of the sac if further dissection is required.

The incised margin of the peritoneal sac is grasped with forceps, inverted, and pushed up into the cul-de-sac. The forceps are gently withdrawn. If necessary this temporary inversion of the peritoneal sac may be reinforced and supported by a small sponge introduced into the sac. This sponge is later removed through the abdominal procedure. With two or three very fine sutures the space between the vagina and the rectum is obliterated. A high attachment of the vagina on the rectum is not required as the redundant amount of vaginal mucosa has been excised, and there has been no prolapse of the rectal wall. As a rule prolapse of anterior rectal wall (rectocele) is not associated with a congenital deep cul-de-sac.

If this congenital cul-de-sac should have become complicated with lacerations of the levator ani muscles, then these muscles will have to be brought together with several interrupted sutures.

The closure of the opening in the posterior vaginal wall is accomplished with a simple continuous catgut suture approximating the margins of the vaginal mucosa.

This is immediately followed by the abdominal procedure which, after the opening of the abdomen, placing the table in Trendelenburg position and packing off the bowel, requires the uterus to be pulled up thereby bringing the cul-de-sac into better view.

Immediately the incised edge of peritoneum that was inverted through the vaginal route is noticed. If a small sponge was used from below as a support, it is now withdrawn.

The freed incised peritoneal sac is grasped with forceps, drawn farther up into the peritoneal cavity and ligated with a suture ligature at its base at a level of a nearly normal cul-de-sac. The sac of peritoneum above the ligated point is cut off. Other work in the abdomen that may be required is now done.

A SIMPLE, BLOODLESS OPERATION FOR ANORECTAL PROLAPSE IN CHILDREN

By C. L. HEALD, M.D., F.A.C.S., Cedar Rapids, Iowa

ANORECTAL prolapse is rather common in children and some cases can be cured by careful, constant attention on the part of the mother or nurse for several, sometimes many, weeks. Correction of intestinal irritation, strapping the buttocks with adhesive, maintaining the recumbent position in defæcation, and, in some cases, supporting the perineum and anus during defæcation, are essential. After apparent cure, careful watching to prevent recurrence is necessary for months (Kerley). Such management is irksome and disagreeable and often it is impossible to have it effectively carried out.

Linear cauterization of the rectal mucosa and muscular wall with the actual cautery is successful in some cases. This procedure is usually followed by severe pain requiring opiates for its relief, and prolonged, careful management is necessary during the slow healing process. Any method depending on considerable destruction of tissue with consequent contraction of cicatrices is obviously objectionable.

I have found the following simple procedure to be all that one could desire in the cure of this troublesome condition.

The intestinal tract is evacuated with milk of magnesia the day before, and by enema 2 hours before the operation.

Under ether or ethylene anæsthesia the child is placed in the dorsal position, its legs being supported by an assistant. After the prolapsed bowel is reduced, a small bivalve rectal speculum is introduced, the blades spread laterally and the lower rectal mucosa swabbed with 1 per cent aqueous solution of mercurochrome. A small rectal retractor on the anterior rectal wall may be used instead of the bivalve speculum.

The index finger is inserted and the notch or angle at the junction of the coccyx and sacrum is located.

A 3 inch, with a 3/8 circle curved needle on one end of a coarse silkworm-gut is passed along the finger in the rectum, inserted through the posterior rectal wall, through the notch at the sacrococcygeal angle and out through the skin posteriorly. A needle on the other end of the suture is passed in the same manner at the same point on the opposite side of the coccyx. A second, similar suture is placed one-half inch lower, emerging on each side of the coccyx.

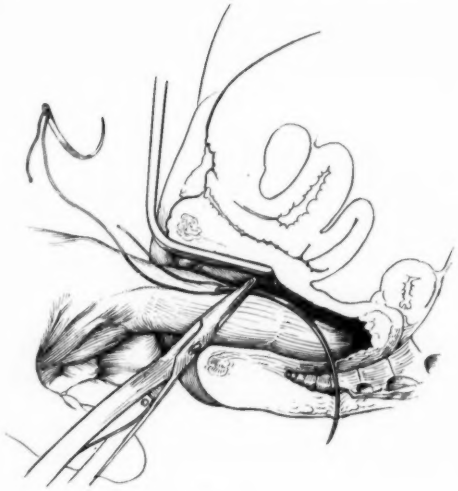


Fig. 1.

The sutures are tied rather tight over a folded gauze compress. The gauze may be kept dry by covering with rubber dam sealed to the skin with narrow strips of adhesive which are protected from moisture by painting with rubber cement.

The child is kept in bed for 3 or 4 days during which time bowel movements are prevented by small doses of paregoric twice daily. When it is desired to move the bowels an enema of 3 or 4 ounces of warm olive oil is given at night, to be retained, and milk of magnesia is given the following morning.

The sutures are removed at the end of 2 weeks.

The efficacy of this method lies in the well-known tendency of silkworm-gut to cut its way through the tissues, when under tension. As the suture slowly cuts through the rectal wall and perirectal tissues, healing by granulation follows in its track with the formation of firm connective tissue adhesions.

It seems probable that a simple procedure like this must have been used by others before me but I have not seen the method described.

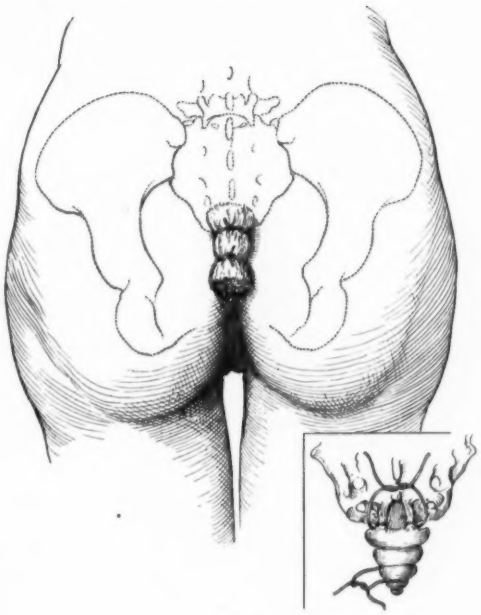


Fig. 2.

NOTE.—Since the above was written, an article by G. Petren in *Acta Chirurgica Scandinavica* (1925, lix, 287–298), "Remote Results after Rectopexy à la Ekehorn for Rectal Prolapse in Children" came to the notice of the writer. Petren reports 26 cases of rectal prolapse in children operated on at the Lund Clinic with uniform ultimate success, by the method of rectopexy originated by Ekehorn of Sweden, with an average hospital sojourn of 18½ days.

Ekehorn's operation, while the same in principle, differs from the technique here described in that a single, heavy silk suture is used and the needle is introduced from the skin surface into the rectum against the operator's finger, which guides the needle out to the anus where it is threaded and retracted, the process being repeated on the other side of the coccyx.

Petren mentions the occurrence of moderate general and local reaction in most cases, with temperatures of 38 degrees C. to 39 degrees C. This reaction may have been the result of the heavy silk suture acting as a wick, and carrying infectious material from the rectum into the perirectal tissues.

A SKELETAL TRACTION CLAMP PERMITTING FULL EXTENSION OF THE EXTREMITY[1]

By J. ALBERT KEY, M.D., St. Louis, Missouri

OF late years skeletal traction has been used extensively both in this country and abroad. The fact that it has been used successfully in a great number of cases would indicate that it can be used in the average surgical clinic with relatively little danger of infection to the bone. In cases in which considerable force is necessary, experience has shown that skeletal traction is more efficient than skin traction. Not only is it more efficient, but when properly applied, it serves to make the patient more comfortable than it is possible to make him during a similar period when he is subjected to an equal pull by skin traction.

Therefore we believe that skeletal traction should be used routinely in most cases of fracture of the shaft of the femur in adults, and in other cases in which a strong pull is indicated, such as the pulling down necessary in an old dislocation of the hip preliminary to operation, the lengthening of an extremity after plastic osteotomy, etc. The only objection to skeletal traction is that its application necessitates a surgical operation, while skin traction does not. In a well equipped hospital, the operation can be quickly and safely done under either general or local anæsthesia, and we feel that the increased efficiency and added comfort to the patient more than outweigh this slight disadvantage.

The usual methods of applying skeletal traction are by the Steinmann pin, the Pearson tongs, or the Finochietto stirrup or by some modification of one of these.

In most cases we have used a modification of the Pearson ice tongs. But in November of 1924 we had a case in which the ice tongs could not be used. The patient was admitted to the hospital with a paralytic dislocation of the right hip and a flexion contracture of the right knee. The knee was straightened by wedging plasters and skeletal traction was applied to the femur to pull it down preliminary to an arthrodesis of the hip. It was important to maintain the knee in extension. This could not be done with the ice tongs which we were then using, therefore a traction clamp was devised and put on the patient in place of the tongs.

Since our clamps were made a modification of the ice tongs in general use has been devised and published by Langworthy.[2] The clamp we describe here is inexpensive, simple, and efficient.

The assembled clamp is shown in Figure 1. The details are shown in Figures 2, 3, 4, and 5. The piece shown in Figure 2 is made of a square rod of Jessup's steel, roughly 16 inches long. One end is sharpened to a long slender point, and the other end is rounded and threaded for a distance of 4½ inches. It is then bent as shown in the figure and a large steel chain link is placed around the base of the tine and is brazed in position. The link projects directly forward at right angles to the plane in which the rod is bent and the point is bent forward about 5 degrees.

To make the piece shown in Figure 3 a piece of square steel rod 6 inches long is sharpened at one end and bent, and a link fitted as in Figure 2. The other end is then brazed to a piece of square steel tubing 6 inches long. The rod and the tube are at right angles to one another. This joint is made very strong by splitting two edges of the tube for a short distance and turning one side down. The rod is then placed in the notch in contact with the opposite side (top) of the tube and brazed solidly in position. A hole is then drilled in the rod in the end of the tube to permit the passage of the threaded end of the piece shown in Figure 2. Near the other end of the steel tube a hole is drilled in the side opposite to that from which the rod projects. A threaded nut is brazed in position over this hole and a thumb screw is fitted into the nut.

To assemble the clamp we push the long end of Figure 2 through the steel tube of Figure 3. A thumb nut is then put on the threaded end. By means of this nut the clamp may be tightened at will, and by means of the thumb screws in the top of the tube it can be set in any position. When the thumb screw is tightened the clamp is rigid.

Second type of clamp. For use with drills or pins passed through the bone we have had clamps made in which instead of the points about half an inch of the rod is turned in and drilled with a hole large enough to admit the end of the pin or drill used in the bone. The details of this construction are shown in Figures 4 and 5. Figure 4 is a view from the inside showing the drill hole in the end of the rod and the manner in which the

[2] Langworthy, M. A new traction frame and caliper for fractured femurs. Surg., Gynec. & Obst., 1925, xl, 125.

[1] From the Shriners' Hospital for Crippled Children, St. Louis Unit.

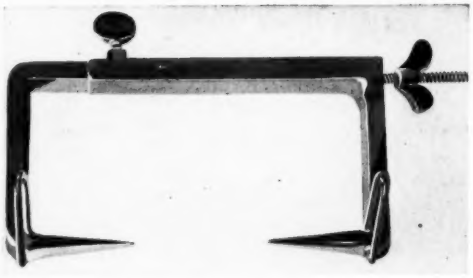
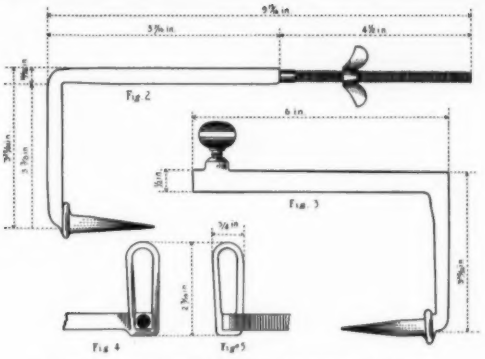


Fig. 1. Drawing showing assembled clamp.



Figs. 2 to 5. Drawing showing parts of clamp.

link fits over the rod. Figure 5 is a view from the outer side, and is the same for both types.

When finished the instrument is nickel plated. The dimensions in the figures are taken by the artist (Mr. Conrath) from a completed clamp and may be altered at will. Our clamps are made in the mechanical shop at the Washington University Medical school.

In applying the traction clamp, the procedure is similar to that used in putting on ice tongs. For the femur the skin is pulled up and an incision is made down to the bone at a point about one half inch above and anterior to the adductor tubercle. The periosteum is cut for a distance of about half an inch. A similar incision is made at a corresponding point on the lateral side of the thigh. The sterilized clamp is then assembled loosely and with the body of the clamp projecting anterior to the thigh, the points are thrust into the bone. The thumb nut is then tightened forcing the points still further into the bone. If one desires, the points may be hammered in. When the desired depth of penetration is reached the thumb nut on the tube is tightened and the clamp is thus locked in position.

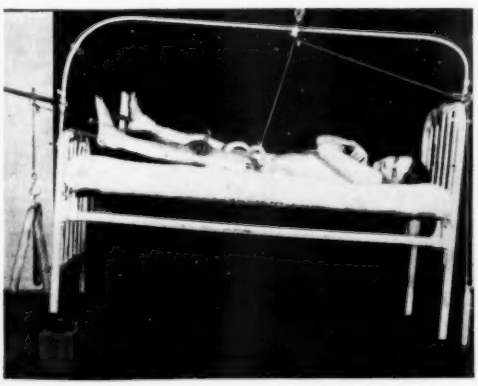


Fig. 6. Traction clamp in use.

It is wise to slip the ring of the Thomas splint over the leg before applying the clamp as the ring may not be large enough to pass over the clamp when in position. After the clamp is in position, it is advisable to enlarge the skin incision below the clamp for a distance of about half an inch to prevent pressure on the skin when traction is applied. The wound is now covered with a thick dressing of gauze soaked in some non irritating antiseptic solution. A saturated alcoholic solution of picric acid is efficient. This is covered with a bandage and the leg adjusted in the Thomas splint.

For applying the traction we use a single rope or chain long enough to pass 6 inches beyond the foot and back to the clamp on the other side. This rope is passed through each end of a metal spreader and the two ends are tied to the links on the clamp. The main traction rope is then passed over the pulley at the foot of the bed. When heavy traction is used it is always advisable to raise the foot of the bed to relieve some of the pressure on the ischium by the body weight, and also to have a small overhead traction to hold the ring snugly against the ischium. A foot piece should be used to prevent foot drop, and in many instances it is advisable to have a hinged leg piece on the Thomas splint to permit movement in the knee. If one prefers intrinsic traction rather than the weight and pulley this can be used with the traction clamp and spreader and ordinary Thomas splint. If the clamp becomes loose after a time, it can be tightened by releasing the thumb screw and tightening the thumb nut. It is important to leave the original antiseptic dressings in place until the clamp is removed. Frequent dressing courts infection. For this reason, the points of

the clamp are made unusually long to permit adjustment of the traction ropes without disturbing the dressings around the points.

In children we always use a pin or drill through the shaft of the bone because of the danger of pulling off the epiphysis by heavy traction. For this purpose we use the second type of clamp described with the holes in place of the tines (Fig. 6).

Our first clamps for this purpose were lighter and simpler to make. The square rod and sleeve tubing are replaced by two flat steel bars. In one of these two, holes are drilled and threaded, and thumb screws fitted. A channel wide enough to admit the screws is cut in the other horizontal bar. This clamp is fitted over the ends of the drill in the bone and locked in position by tightening the screws. This apparatus lacks the screw adjustment for tightening the clamp, but for pin traction it is quite as efficient as the more expensive type.

Figure 6 is a photograph of the traction clamp in use. This patient, a boy twelve years of age, had had 30 pounds traction for 3 weeks. After the photograph was taken, 10 more pounds were added with no ill effects.

A PLASTIC OPERATION FOR REDUCTION OF OLD TRANSVERSE FRACTURES OF THE DISTAL END OF THE RADIUS, HEALED WITH DISPLACEMENT AND DEFORMITY

By LAWSON THORNTON, M.D., Atlanta, Georgia

FRACTURE of the distal end of the radius in children almost always takes place transversely through the newly formed bone adjacent to the epiphysis. Displacement of the upper fragment may be either backward or forward. If backward, the periosteum is stripped from the anterior aspect of the shaft of the bone; if forward, it is separated from the dorsal surface. A triangular space is thus formed between the periosteum, the cortex of the upper fragment, and the fractured surface of the distal fragment. If, for any reason, the fracture is not reduced, this triangular area becomes filled with new bone within a very short while, and then reduction can be done only by an open operation.

Fig. 1. Drawing of transverse fracture of the distal end of the radius healed with posterior displacement of the upper fragment. The triangular area between the anterior cortex of the upper fragment, the fractured surface of the distal fragment, and the periosteum of the upper fragment is filled with callus.

Old healed fractures of this type, with deformity either of anterior or posterior displacement, are not infrequently presented to the surgeon for reduction. Removal of the callus in the subperi-

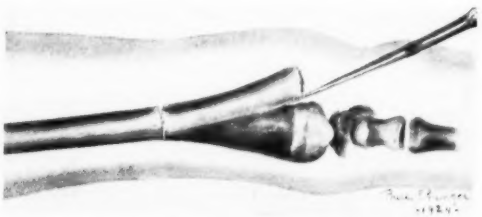


Fig. 2. Drawing shows a section of the original shaft of the radius being excised along the line of cleavage between the old and the new bone.

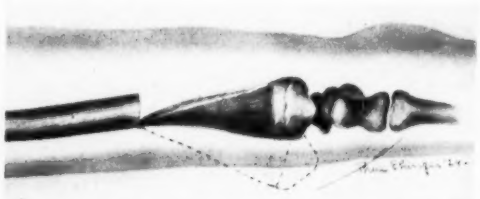


Fig. 3. The distal section of the radius is swung on its osteoperiosteal hinge into normal alinement. The triangular callus is thus permitted to serve as a portion of the distal end of the shaft.

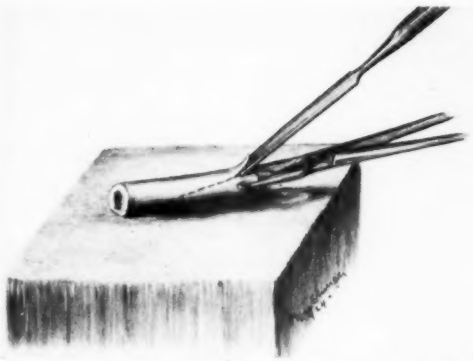


Fig. 4. The removed section of the original shaft of the radius is carved upon a wooden block in such a fashion that it will fit accurately into the triangular space from which it was taken.

osteal triangle described above plus refracture and reduction is not easily executed.

The method pictured in the accompanying illustrations is a more simple plastic procedure, and restores normal anatomical position. In case of

Fig. 5. The plastic operation completed. The replaced section of bone is held in place by a snug periosteal closure.

posterior displacement of the upper fragment, the incision is made on the dorsum of the forearm. An anterior incision is made in case of anterior displacement of this fragment. The bone is exposed by subperiosteal dissection.

The drawings show the details of the plastic sculptural procedure. The arm is immobilized in a plaster-of-Paris cast extending from the fingers to the axilla with the elbow flexed. Postoperative roentgenograms should be made at intervals to keep a check-up on the alinement. Immobilization in a cast for 6 weeks is usually required until firm bony union has occurred.

SURGICAL REMOVAL AND PATHOLOGICAL STUDY OF A MASSIVE SQUAMOUS CELL EPITHELIOMA ASSOCIATED WITH ANGIOMA OF THE SCALP[1]

By D. SCHUYLER PULFORD, M.D., Rochester, Minnesota
Section on Surgical Pathology
AND
ALFRED W. ADSON, M.D., Rochester, Minnesota
Section on Neurologic Surgery, Mayo Clinic

A MALIGNANT growth developing in an angioma is usually an endothelioma and is never epithelial in nature. Of 200 tumors of the blood vascular system reported recently by Pulford, 183 were benign angiomata, 9 were endotheliomata, and eight angio-endotheliomata. Pulford reported a case and presented photomicrographs, showing the transition from benign angioma to malignant angio-endothelioma. Numerous reports can be found in the literature describing malignant change in moles, warts, sebaceous cysts and the affected tissues in keratosis, and leucoplakia. These are all recognized now as types of epitheliomata, although the pigmented ones were long thought to be mesenchymal in origin and called melanotic sarcomata. Caylor has recently reported a series of 236 cases of sebaceous cyst of which 65 were of the scalp. Three of the patients had developed squamous cell epitheliomata, two of grade 1 and one of grade 3.

The case herein reported is of interest from the pathological standpoint, since it illustrates a malignant squamous cell epithelioma arising from the epithelium overlying a benign angioma, and because although approximately one-half of the tumor was angiomatous, the malignant growth was not an angio-endothelioma as might have been expected, but an epithelioma arising from the epidermic elements overlying the vascular growth. The epithelium overlying an angioma usually undergoes hyperplasia, espe-

Fig. 1. Grade 1 squamous-cell epithelioma in a massive angioma of the scalp.

Fig. 2. Granulating wound following removal of outer table of bone.

[1]Submitted for Publication October 15, 1925.

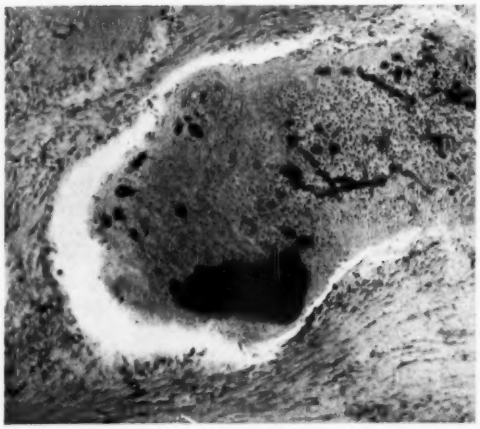


Fig. 3. Calcareous deposits in fibro-angiomatous areas of the scalp (x 60).

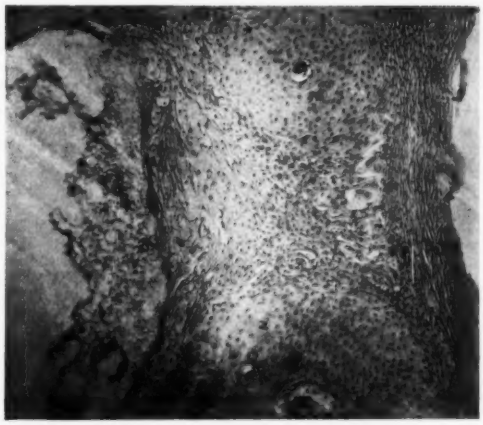


Fig. 4. Pearl formation and almost complete differentiation in grade 1, squamous-cell epithelioma of the scalp (x 60).

cially when the angioma is large. This hyperplasia may be the result of irritation, or of pressure, or may be a protective process. In this case hyperplasia has gone on to malignant change. This case is of further interest from the surgical point of view, since it had lasted 29 years and had been considered malignant and inoperable on account of its extensiveness and its hæmorrhagic character.

REPORT OF A CASE

CASE 1. A woman, aged 56, entered the clinic in March, 1924, complaining of a growth on the head. There was no history of syphilis and no family history of malignant disease or tuberculosis. In 1895, when she was 27 years of age, she noticed a small lump on the back of her head. It gradually grew larger until 4 months later the discharge of considerable, thick, caseous material was followed by almost complete disappearance of the tumor. Eleven years later the swelling reappeared in the same area, and again increased in size. Two years before her admission to the clinic, the growth of the tumor became much more rapid and had doubled in size. There were intermittent pains in the region of the growth, but they did not radiate. She had had no headache, visual disturbance, nausea, or vomiting, and had observed no other tumors. Ulceration and secondary infection of the tumor had been present for several years. She had become pale, weak, and easily tired, but had not recently lost weight.

When she was admitted she seemed in fairly good health and well nourished, but was pale and weak. From the nape of the neck upward and outward over the occiput to the vertex of the skull was an ulcerated, infected, foul, oozing tumor, measuring about 24 by 17 by 12 centimeters. It was studded with many small projecting nodules, all of which were extremely vascular. The temperature was 99.2 degrees; the pulse rate 84, the systolic blood pressure 152, and the diastolic 80. The urine showed a faint trace of albumin, occasional erythrocytes, and 30 pus cells to the field. The hæmoglobin was 55 per cent; the erythrocytes numbered 3,390,000, and the leucocytes 11,900, the color index being 0.8. Roentgenograms of the chest were negative, but those of the skull showed a soft tissue tumor, attached to and roughening the occipital bone and attended by the formation of new bone giving ground for a suspicion of malignant disease. Neurological examination was entirely negative. A tentative diagnosis of a secondary malignant process of a sebaceous cyst was made, and surgical removal was advised (Fig. 1).

Radical operation was not undertaken without carefully weighing the risks and difficulties. The patient was 56 years of age, in appearance much older, anæmic, and very weak. The tumor was large and contained numerous large vessels which extended from the scalp. It had apparently caused some roughening of the occipital bone which meant either erosion or invasion of the bone, which in turn would necessitate removal of the tumor and tissues at least down to the skull itself. Treatment of this denuded bone with the object of stimulating granulation and epithelization would probably be difficult and lengthy. In order to avoid too great surgical shock and prevent hæmorrhage, the operation was performed under local anæsthesia by the infiltration method, and the bleeding was prevented by use of the Heidenhain suture, that is, a continuous suture of catgut placed around the periphery in such a manner as to compress the entire thickness of the scalp. The first stitch was tied, while the remaining stitches were placed in running fashion from the surface of the skin to the pericranium, the needle always emerging 2 centimeters from its point of entrance, and entering the skin half way between that point and that of the previous exit. Following operation, every alternate stitch was cut in order to relieve some of the compression of the scalp, and individual large vessels were tied. On the second day after operation all of the catgut was removed. The tumor was excised by electrocautery, the incision being carried through the skin well beyond the boundary of the tumor and through the galea and the periosteum of the skull so as to permit removal of the tumor *en masse* with the periosteum. The roughening of the skull was due to pressure erosion and not invasion, so that the entire tumor would be elevated with the periosteum. After the tumor had been freed from the vertex and occiput, it was turned backward over the nape of the neck, where removal was completed by resection of the superficial layer

of muscle with the tumor. Cautery was used for the entire removal. There was practically no bleeding, and the patient experienced no pain; the larger veins and arteries were tied to prevent subsequent hæmorrhage. The wound was then covered with boric acid powder and a dry dressing was applied. In view of our former experience with denuded bone, we undertook on the sixteenth day after operation and without using any anæsthetic, the removal of the outer table from the posterior portion of the parietal and occipital bones in order to expose diploe which would produce granulation tissue. This wound was covered with an alcohol dressing until there was an even granulating surface, and then instead of grafting skin, paraffin was applied, as is so frequently done in the treatment of burns; that is, the granulating tissue was covered daily with a coat of paraffin and protected by a wire basket especially constructed to prevent the gauze from rubbing the paraffin. Since skin grafting would have necessitated the patient's remaining in hospital for a protracted period, she was permitted to return home under paraffin treatment. Her convalescence was uneventful and satisfactory, and there was complete epithelization of the denuded area, without any evidence of recurrence.

The specimen consisted of a rough, hard, ulcerated, infected mass with normal skin and hair on the margins and with the occipitofrontalis fascia and some muscle on the under surface. Most of the upper surface was studded with tuberous growths about 0.5 to 3 centimeters in diameter, with ulcerated tissue between. The cut surface showed multilocular cysts and channels, some filled with blood and others with gelatinous or with caseous material. The tumor measured, when fixed in formalin, 21 by 19 by 9 centimeters and weighed 1552 grams.

Many sections taken through different parts of the tumor showed that the tissue was about equally divided between fibro-angiomatous tissue and a warty epithelial structure. The cavernous nature of the angiomatous areas together with the associated dense fibrous-tissue bands established the benignancy of this part of the tumor. Growth and proliferation of the squamous epithelium, however, was quite active and in some areas actual squamous-cell epithelioma was found. The large amount of completely differentiated squamous epithelium seen in the form of cholesteotomatous masses and the almost complete differentiation of the squamous epithelium throughout placed the tumor in the lowest grade of Broders' classification of malignancy, that is, grade 1. There was an attempt on the part of nature completely to eradicate the keratin masses of differentiated epithelium by depositing calcium in and about them, enough for the roentgen-ray to cast a shadow.

The interesting feature of this tumor from the pathological standpoint is that although the bulk of it was at first angiomatous the malignancy developed in the overlying epithelial structures producing a squamous-cell epithelioma, instead, as might have been expected, a tumor of fibrous tissue or endothelium. The fact that it might have started on a sebaceous cyst to be later overshadowed by telangiectasia is to be remembered. Although there is often epithelial hyperplasia over an angioma of the skin it rarely becomes malignant. This case also illustrates how little the diagnosis of malignancy helps in prognosis unless the tumor is graded and the degree of malignancy stated. This patient had been told repeatedly by various physicians over more than a score of years that she had an incurable tumor, that it was malignant, and that there was no hope for her. A biopsy showing the malignancy to be grade 1 would have prompted earlier operation, and would have saved the patient much pain, worry and expense.

The term nævus epitheliomatosis is avoided in this case as this term applies to a wart or a mole which has become malignant. The tumor under discussion arose from a sebaceous cyst or an angioma.

CONCLUSIONS

1. Surgical shock can be minimized by the use of local anæsthetics in extensive superficial vascular lesions, and bleeding can be prevented in the removal of superficial angiomata by the use of the Heidenhain suture.

2. The cautery knife may be of some aid in controlling capillary oozing and in causing lymphatic block during the removal of the tumor.

3. Epithelization can be accomplished over denuded bone by removal of the outer table and subsequent treatment of the granulating area with paraffin.

4. Angiomatous tumors may be associated with squamous-cell epitheliomata from progressive changes in the overlying hyperplastic epithelium. In such cases the angioma may be considered the indirect cause of the epithelioma.

5. Doubtful tumors should be sectioned for biopsy. If malignant they should be graded before operative procedures are completed or prognosis is stated.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JUNE, 1926

THE TOXÆMIA OF ACUTE DUODENAL AND GASTRIC FISTULA

IN the cases of duodenal fistula reported by Colp, Cameron, Rigby, and others, no explanation has been given for the associated toxæmia. Studies of the chemical changes in the blood accompanying acute clinical and experimental duodenal and experimental gastric fistula show that in all instances there is decreasing concentration of chlorides, progressive rise of urea, and a rising carbon dioxide combining power of the blood plasma. In cases of experimental acute gastric fistula, there is greater increase in the carbon dioxide combining power of the plasma than in cases of duodenal fistula, due to the greater loss of acid from the body through the fistula. The decrease in the chloride content of the blood is quite comparable to that found in cases of high intestinal stasis by Brown, Eusterman, Hartman, and Rowntree, and by Haden, Orr, and McVicar. Haden and Orr showed that the nearer the obstruction to the pylorus of the stomach the greater the toxæmia; this might be explained on the hypothesis that the loss of chlorides from the blood and tissues in such cases was due to their excretion into the lumen of the intestine, whereas in cases of experimental gastric fistula the chlorides were lost from the body by excretion through the fistula. In experimental acute gastric fistula, as in acute duodenal fistula, the part played by interruption in the continuity of the gastrointestinal tract by the fistula must also be considered.

It has been possible to control the toxæmia accompanying acute duodenal and gastric fistula by intravenous injections of isotonic sodium chloride solution. Fluid balance seems to play an important part, for these injections in concentrated solution, even if in sufficient amount to raise the blood chlorides to normal, have practically no effect in lengthening the life of animals with duodenal fistula. If, however, a sufficient volume of water is added to the sodium chloride and this solution given twice daily, life may be maintained for 3 weeks or longer, during which time the blood chlorides are not only raised to their normal level, but non-protein nitrogen is prevented from accumulating in the blood. Intravenous injections of isotonic glucose solution and sodium sulphate solutions, although they assist in the elimination of the non-protein nitrogen retained in the blood, have no effect on the blood chlorides, and the dogs die as quickly as though no intravenous injections had been given. The amount of nitrogen lost in the urine and in the fistulous fluids is increased somewhat above the normal level (although there is definite evidence of retention of nitrogen) until just before death, when

a decrease in the excretion of nitrogen accompanies anuria.

To determine the effect of loss of bile and pancreatic secretion through a duodenal fistula, the common bile duct and both pancreatic ducts have been transplanted into the jejunum of two dogs, as a consequence of which neither the bile nor the pancreatic secretions are lost through the duodenal fistula. These dogs show the same chemical changes in the blood as the dogs with duodenal fistula the ducts of which have not been transplanted.

The intravenous injection of large quantities of the physiological solution of sodium chloride to control the toxæmia accompanying acute gastric and duodenal fistula, combined with the suction method of Erdman, Cameron, and Lahey for removing the fistulous fluid and thus preventing digestion and absorption of the proteins of the skin, should be first tried in the treatment of all such fistulæ. Glucose can be added to the solution of sodium chloride if necessary in order to supply the patient with calories for heat and energy. Should the fistula be large and fail to heal, operation can be more safely performed because of the control of the associated toxæmia of the acute fistula by the intravenous injection of sodium chloride solution.

WALTMAN WALTERS.

PHYSICAL EXAMINATION OF PATIENTS WITH OCULAR DISEASE

FOR many years syphilis and tuberculosis have been the catchalls in which has been thrown the blame for inflammatory diseases of the eye that could not definitely be ascribed to some other cause. Pathologists have at times added to the clinician's confusion by ascribing to syphilis inflammatory processes in the tissues of the orbit of uncertain origin, even in the absence of all clinical and biochemical evidence of that disease. The presence of clinical signs of syphilis or a positive Wassermann reaction is almost sure to mask any other etiological factor that may be present.

Any inflammatory lesion of the eye or any swelling about the orbit that is reduced by the use of mercury and iodides is suspected of being due to syphilis. While it may be impossible definitely to exclude syphilis, it should be borne in mind that mercury and iodides are effective therapeutic agents for many other conditions.

Even when tuberculosis of some organ remote from the eye is discovered at necropsy, if no sign of the disease was elicited during life, and tuberculin was administered as a diagnostic test, there is little grounds for ascribing tuberculosis as the cause of minor inflammatory lesions of the eye in the absence of any other clinical manifestations of the disease. Since the advent of foreign protein therapy the tuberculin test has lost some of the significance formerly attributed to it.

The relationship between inflammatory disease of the eye and focal infection had been clearly demonstrated in series of cases in which careful examination and observation have been made. The evaluation of foci of infection as etiological agents is gradually being established in the minds of those who are thoroughly investigating a sufficient number of cases. The most serious impediment to the realization of the rôle of focal infection is the incomplete search for foci in the physical examination. Another fault lies in the failure of the examining physician to realize that a small area of infection giving no local disturbance could be held to account for active inflammation elsewhere in the body. A certain ophthalmologist's judgment of focal

infection is based on the attitude of a dentist friend who insists on keeping a devitalized tooth, which he knows has been abscessed at the root for many years, because it causes no local disturbance and because his general health is good.

Hundreds of patients have been subjected to nasal operations and tonsillectomy and dental extractions before complete examinations have been made, in an effort to clear the body of infection.

Although the teeth and tonsils are the most common foci of infection, numerous cases are reported in which there is infection in the pelvic organs, in the appendix and in the gall bladder, showing quite clearly that infectious areas may be far from the eye yet intimately connected with the origin and course of the disease of the eye. A physical examination designed to reveal the cause of inflammatory disease of the eye is not complete until reasonable attention has been given to the genital organs as possible sources of infection, and a local therapeutic regimen established. The importance of infection of these organs in cases of iritis and episcleritis is established. The examining physician must recognize this fact and consider the cervix and the prostate as possible foci of infection equal in importance to the tonsils and teeth, so far as disease of the eye is concerned. The ophthalmologist owes it to himself and to his patient to insist that the patient shall be thoroughly examined.

WILLIAM L. BENEDICT

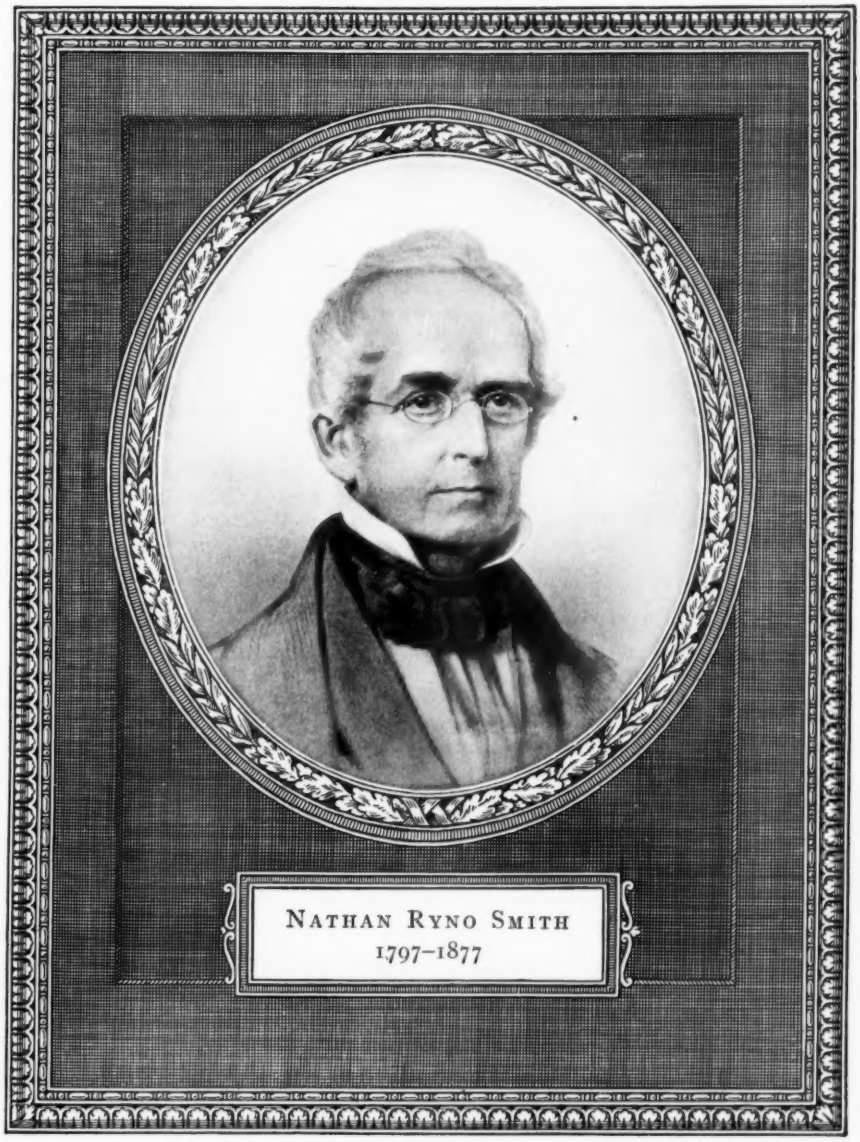
MASTER SURGEONS OF AMERICA

NATHAN RYNO SMITH

AMONG the outstanding figures in the American medical world during the middle period of the last century, Nathan Ryno Smith will always occupy a conspicuous position. He was born in Cornish, New Hampshire, on May 21, 1797; being the second son of an illustrious father, Dr. Nathan Smith, professor of medicine and surgery in the Medical School of Yale College.

Dr. Nathan R. Smith received his classical education at Yale, from which institution he graduated in 1817, with the degree of bachelor of arts. He also pursued his medical studies at Yale College and received the degree of doctor of medicine there in 1823. Following his graduation he settled at Burlington, Vermont, in 1824, and began to practice his profession. In 1825, in conjunction with his father, he organized the Medical School of the University of Vermont and was appointed its first professor of anatomy and surgery. Feeling the need of further instruction in order to fit himself for the position of a teacher, he spent the winter of 1825–1826 in Philadelphia, in attendance on the lectures at the University of Pennsylvania. While in that city he became associated with Dr. George McClellan and others, in organizing the Jefferson Medical College and was elected to the professorship of anatomy, which chair he filled during two sessions. Among his pupils at Jefferson Medical College were Samuel Gross, subsequently professor of surgery in the same institution and for many years considered the Nestor of American surgery, and Washington L. Atlee, a renowned ovariotomist.

In 1827 he was called to Baltimore as professor of anatomy in the University of Maryland, but after a short while he was transferred to the chair of surgery—a position that he held, except for a brief intermission, for over 40 years. He found Baltimore a ripe field for surgical practice, and so thoroughly did he dominate surgical thought and work in that city and the state of Maryland that he became known widely as the "Emperor," and to this day those of his pupils who are still living cling to this title in affectionate remembrance of their distinguished master. At the time of his removal to Baltimore he was about 30 years of age and he continued to reside there until his death in 1877. Owing to dissensions between the trustees and the faculty of the University of Maryland, in 1838 Dr. Smith accepted the chair of practice of medicine in Transylvania



NATHAN RYNO SMITH
1797–1877

University at Lexington, Kentucky, and for three sessions he traveled to and fro to fulfill the duties of his position. He delivered some lectures during this time at the University of Maryland also, and upon the readjustment of the affairs at this institution he resumed the professorship of surgery in 1840 and continued his courses of instruction until 1870, when advancing years and physical infirmities impelled him to relinquish active participation in the work of the medical school and to retire with the rank of emeritus professor of surgery. As late as 1873–1874 he held occasional clinics at the University Hospital, and the writer remembers attending one in which he said: "Anybody can do good work with good tools, but it takes a surgeon to do good work with poor tools," and as an illustration he mentioned that on one occasion, while he was on a railroad train, a man was injured to such an extent that an amputation became necessary. The man was placed in the baggage car and an operating table improvised. Dr. Smith did not have any amputating instruments with him, but with a butcher's knife and a carpenter's saw the leg was amputated and the stump was dressed before he reached the city. This was before the era of antiseptic and aseptic surgery, and I do not remember that he stated the result of the operation. On another occasion he said he had been called to see a highly nervous boy suffering with a large abscess of the thigh. To allay the patient's apprehension he was introduced as Cousin John and he suggested that he be allowed to look at the inflamed spot. When he had seen it he said he thought it would soothe it if he washed and shaved it and asked if he could have a razor. The razor was brought and he proceeded to shave the area, but after making a few passes he turned the edge of the razor down and made the required incision. The boy with a scream said: "You are not Cousin John. You are the old devil. Your name is Smith." Cordell, the medical historian, says: "Professor Smith was a man of commanding presence, fully 6 feet in height, with clean-shaven face, a well-shaped Grecian nose, long thin compressed lips, piercing eyes surrounded by shaggy eyebrows, a well poised head and a long neck, concealed by an old fashioned black stock and standing collar. He was near-sighted, and wore glasses. He lectured without notes, in slow, deliberate fashion, in a voice of medium pitch, distinct, though not strong."

He was an indefatigable worker and was accustomed to make his rounds at the Baltimore Infirmary, now the University Hospital, about 6.30 o'clock in the morning; on which he was accompanied by his residents and students. Whilst his surgical work was varied and extensive, his reputation rests chiefly on his lithotome, an instrument for the performance of vesical lithotomy, and the anterior splint. It is said that he operated for stone in the bladder about 350 times, with a very low mortality; a large portion of his success, as well as that of his son, Dr. Alan P. Smith, in these operations being due to the use of this lithotome. Dr. Smith's lithotome was an ingenious but simple instrument for the

performance of perineal lithotomy, by means of which the extraction of calculi from the urinary bladder was rendered easy and safe. A distinguished professor of Surgery is said to have remarked, "With it anyone could operate." The anterior splint for the treatment of fractures of the lower extremities was a great improvement on the methods in vogue at that time, and was considered by Professor Smith to have been his chief contribution to surgery. This suspensory apparatus has now fallen into undeserved disuse and is as capable of rendering good service now as it was when perfected by him in 1860. The principle upon which this was based was that of the double inclined plane, with suspension. During the Civil War the anterior splint was used with the greatest benefit and comfort in the treatment of soldiers suffering from compound gunshot fractures of the lower extremities. The Hodgen splint, which is used satisfactorily in some parts of this country, is merely a modification of Smith's anterior splint, and the usefulness of both of these appliances is due to the fact that the limb can be swung and a certain amount of motion permitted without interfering with the healing process. The same principles were applied in the treatment of fractures in the late World War, but with greater provision for extension than was possible with the original anterior splint.

As early as 1835 Dr. Smith performed a complete thyroidectomy for a large ulcerating tumor of the thyroid body, without anæsthesia and with no artery forceps nor other appropriate methods of hæmostasis. The patient survived for 13 days and died with symptoms of pyæmia. The late Professor Halsted says: "Nathan R. Smith had quite surely never seen an operation performed on the thyroid gland, and it is not unlikely that he had never heard of such an operation. My admiration for Dr. Smith, Baltimore's 'Emperor,' has been greatly increased since reading his modest and lucid report of a case, the importance of which he could hardly have comprehended." Dr. Halsted considers this operation to have been *the chef d'oeuvre* of Nathan R. Smith. The late Professor Samuel D. Gross says: "Dr. Smith was one of the most distinguished surgeons that our country has produced. As a mechanical surgeon he has justly occupied a high rank."

Dr. Smith was a frequent contributor to surgical literature and was the author of several books, the most important of which are *Memoirs, Medical and Surgical, of Dr. Nathan Smith,* with additions by the author, 1831; *Surgical Anatomy of the Arteries,* 1830; *Fractures of the Lower Extremity and Use of Suspensory Apparatus,* 1867, and *Legends of the South,* 1869. He received the degree of doctor of laws from Princeton College in 1852. In 1867 when he was 70 years of age, he made his first and only visit to Europe and was received with great distinction by the leading surgeons of Great Britain and the Continent and on his return to this country he was the recipient of a great ovation from his friends and admirers. He continued to meet his classes for 2 years longer and then retired from his chair.

RANDOLPH WINSLOW.

UNIV. OF MICH.

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OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE GUNPOWDER SURGERY OF WILLIAM CLOWES

THE British Isles, during the sixteenth century, furnished their due quota of surgeons who aided in raising surgery from the low and almost menial position which it had held during the middle ages and in lifting it to a plane almost coequal with internal medicine. In 1512 the Company of Barber Surgeons of London procured a new charter from King Henry VIII which forbade the practice of surgery within the city of London and seven miles around it, to others than members of the Company. Scotland had preceded this by obtaining a charter for the Royal College of Surgeons of Edinburg in 1505, the rules of which attempted to limit the practice of surgery to those duly qualified. By the middle of the century the limitation of practice of surgery was thus fairly established, and opportunity for surgical advancement was possible. At approximately this time, in 1540, William Clowes was born in Kingsbury, Warwickshire. As was then the custom, he learned surgery by practice under his master, one George Keble, in London, and when 23 years of age became an army surgeon and served in the campaign in France under the command of Earl Ambrose of Warwick. Here he had an excellent opportunity to study the surgery of war, for in the early part of the century, 1513–14, it had been decided that the surgeons should be considered "as Herawdes of Armes, as well in batelles and feldes as other places, ther for to stand unharnessed and unwapenned, according to the lawe of armes, because they be persones that never use feats of warre, nor ought to use, but only the besynes and exercise of their science, to the helpe and comfort of the Kinges liege people in the tyme of their nede." Consequently the surgeon had only to treat the sick and wounded.

Clowes busied himself in the army for six years and on his return to London in 1569 was received into the "Barber Surgeons Company," which in 1540 by a formal act of Parliament had become incorporated with the "Fellowship of Surgeons." Thus he became a full fledged surgeon. He practiced then in London and attained considerable recognition for in 1557 he was appointed on the Staff of St. Bartholomew's Hospital as one of its three surgeons. In this same year he published his book on the cure of syphilis by inunctions. He became also surgeon to Christ's Hospital and apparently seemed settled in London.

The call of war surgery, however, was too strong and in 1585 he again entered service in the army of the Earl of Leicester. At the close of the campaign he returned to London and in 1588 was made a Master of the Court of the Barber Surgeons Company. In this same year he published his most famous work which appeared under the title "A proved practise for all young chirurgians, concerning burnings with gun-powder, and wounds, made with gunshot, sword, halbard, pike, launce, or such other. London, 1588." Later the title was changed and in 1596 it appeared as "A PROFITABLE AND NECESSARIE Booke of observations, for all those that are burned with the flame of Gun powder," &c.[1] A still later edition appeared in 1637[2] thirty-three years after his death.

I have had the opportunity of examining these two editions. They are identical even to pagination with the one exception that p. 140 of the 1596 edition shows a cut of the Surgery Chest while the corresponding page of the 1637 edition shows the more familiar table covered with instruments. In Dr. Cushing's copy of the 1637 edition is inserted a photograph of the title page of the Surgery of John de Vigo 1586, which bears William Clowes' signature.

Clowes was a practical surgeon and so the greater portion of the surgery consists of a recital of case histories. They are couched in simple clear English and give a detailed account of his treatment in each case. He had, of course, great faith in various ointments for dressings but he also had good judgment as to when to interfere and when to bide his time. Many of his methods were ingenious and some original. He was a well read man for he refers to the dicta of most of the well known writers of previous times and is most careful to give credit to them for ideas which he borrowed and technique that he used. In two cases of an abdominal wound with protruding omentum he used the ligature and removed the protruding omentum.

He closes his book, as do most surgeons of the time, with a plea for charity for his opinions. The book is delightful reading, and Clowes deserves to be considered as one of the originators of clinical teaching by case histories.

[1] Courtesy of the Rosenbach Galleries, New York.
[2] Courtesy of Dr. Harvey Cushing, Boston, Massachusetts.

REVIEWS OF NEW BOOKS

AN authoritative discussion on basal metabolism[1] comes to us from the source of much of our fundamental knowledge of metabolic phenomena, Dr. DuBois. The book is exact, thorough, and abundantly illustrated. The discussion begins with a consideration of the simple phenomena of metabolism—the transformation of food and air into energy in the body. A valuable brief review of the necessary physical laws is given. The principles and mechanics of nearly all the machines used for the measurement of basal metabolism, either directly or indirectly, including the simplest and most recent, are explained and illustrated. Normal basal metabolism with its variations in age groups is considered with many charts and tables; and, the mathematical basis for relating the results of heat, gas, or energy measurements to body surface is explained. This knowledge is essential for all those using basal metabolism estimations. The succeeding chapters cover the findings in undernutrition, obesity, diabetes, thyroid and other endocrine disorders, blood diseases, cardiovascular conditions, fever, and disturbances of water metabolism. They constitute a thoroughgoing summary of the metabolic rate findings in disease. The book should be of great value to the technician and clinician. PAUL STARR.

THE Illustrated Practical Surgery[2] from the clinic of Victor Pauchet, of which two volumes just appearing are numbered vii and viii, constitutes an operative atlas rather than a textbook of surgery. It is profusely illustrated with unique and exceptionally lucid semi-diagrammatic drawings by Dupret, which are sufficiently self-explanatory as scarcely to require descriptive legend. The brief text is written in a flashing, individual, easy reading style. It concerns itself essentially with operative technique; the problems dealt with are chiefly the mechanical ones encountered, while the diagnosis, indications, and choice of operation are based largely upon anatomical grounds and not upon a profound and exact understanding of the physiology and pathology of the structures involved. One suggestion we would like to make is that there is a seeming lack of sequence in the arrangement in the world of material presented which detracts from the value of the work as a reference book. L. M. ZIMMERMAN.

PAUL'S Selected papers,[3] collected and printed by his colleagues in honor of his seventy-fifth birthday, form a volume of intense interes Those who enjoy the study of the development of our surgical science will find in these papers a history of certain phases of surgical procedure beginning at the conception of the idea and evolving step by step the final practical operation. Paul's name has long been associated with intestinal resection especially for malignancy of the colon. His earliest papers on colectomy graphically describe his pioneer attempts to combat what seemed to be a hopeless condition. Then as success alternating with failure attended his efforts he changed his technique overcoming one by one the obstacles in his path, until finally his practical operation for colectomy was developed. Paul's papers are particularly interesting because the reader is permitted to follow the various lines of reasoning by which this eminent thinker reached his goal.

Paul was a philosopher of surgery as well as a doctor, and his collected papers will appeal to all surgeons who approach the profession with the open philosophical mind of the sincere student.

RALPH B. BETTMAN.

ERRORS in diagnosis and treatment are often made and seldom reported. J. Schwalbe, editor of many valuable contributions has undertaken a great task in publishing short monographs on this subject by leading clinicians. The seventh section of the surgical series which appeared recently[4] treats of the injuries and surgical diseases of the mouth, nasopharynx, neck, salivary glands, œsophagus, larynx, and trachea. With the eye of an experienced clinician, Paul Clairmont throws off the ballast of unessentials and points out in clear concise form the possible mistakes in diagnosis and treatment. Besides a great deal of personal experience, he uses contemporary literature to a great extent and gives many instructive illustrations. While the importance of laboratory methods is emphasized and their systematic use required, clinical symptoms are placed in the foreground. In a few forceful words really classic descriptions are given by the author who has had great clinical experience with many years of teaching. Some very striking mistakes in histological diagnosis made by prominent pathologists, some unnecessary operations, and cases of faulty after-treatment are pointed out with perfect frankness. The chapter on the newer phases of the goiter problem is especially successful.

On the whole this volume gives a true picture of the present difficulties of diagnosis and treatment. Its precise style, the faculty of close clinical observation, the sound atmosphere of simple clinical signs with a systematic but cautious use of laboratory findings are characteristic of the school that Professor Clairmont represents. Sometimes in a short, powerful description, in a small remark, the classic lectures of Baron Eiselsberg can be recognized. A reading of this book is highly recommended. G. DE TAKATS.

[1] BASAL METABOLISM IN HEALTH AND DISEASE. By Eugene F. DuBois, M.D. Philadelphia: Lea and Febiger, 1924.

[2] LA PRATIQUE CHIRURGICALE ILLUSTRÉE. By Victor Pauchet. Vols. vii and viii. Paris: Librairie Octave Doin, 1925.

[3] SELECTED PAPERS, SURGICAL AND PATHOLOGICAL. By F. T. Paul, D.Sc., Ch.M., F.R.C.S. London: Bailliere, Tindall and Cox, 1925.

[4] DIAGNOSTISCHE UND THERAPEUTISCHE IRRTUEMER UND DEREN VERHUETUNG. CHIRURGIE. Edited by Prof. J. Schwalbe. Vol. vii. Verletzungen und chirurgische Krankheiten der Mund- und Rachenhoehle, etc., by Prof. Paul Clairmont. Leipzig: Paul Thieme, 1926.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

RUDOLPH MATAS, New Orleans, *President* WALTER W. CHIPMAN, Montreal, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*

MONTREAL COMMITTEE ON ARRANGEMENTS

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OSCAR F. MERCIER
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WILLIAM G. TURNER

PRELIMINARY CLINICAL PROGRAM FOR THE MONTREAL MEETING

IN the following pages appears a preliminary program of clinics and demonstrations arranged for the sixteenth annual Clinical Congress of the American College of Surgeons, to be held in Montreal, October 25 to 29, 1926. The program here published is a tentative outline and will be revised and amplified during the coming months as the work of the Committee on Arrangements progresses, so that the final program will adequately represent the clinical activities of Canada's great medical center in all departments of surgery, including general surgery, gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat and mouth. When next published the program will include an outline of a special series of clinics, demonstrations and papers that will be of particular interest to those who practice surgery of the eye, ear, nose, and throat, such a program being in the course of preparation by a committee of which Dr. Albert LaSalle, ophthalmic surgeon at the Hotel Dieu, is chairman.

Those who attended the 1920 session of the Clinical Congress will recall with pleasure the splendid clinical program offered by the surgeons of Montreal, and it may be confidently expected that the program for this year's meeting will provide a larger and still more interesting series of clinics. Since 1920 a number of new hospitals have been built and additions made to the older hospitals, so that clinical facilities in that city have been very greatly increased. Clinics and demonstrations are to be given in the following institutions: McGill University and University of Montreal Medical Schools; the Children's Memorial, Hotel Dieu, Misericordia, Montreal General, Notre Dame, Royal Victoria, St. Justine, and Shriners' Hospitals.

The program for the scientific meetings, to be held each evening in Windsor Hall, at the Windsor Hotel, is being prepared by the Executive Committee of the Clinical Congress, Papers dealing with important surgical questions of present day interest will be read and discussed by eminent surgeons of the United States and Canada, and by distinguished surgeons from abroad.

The Presidential Meeting, the first formal session of the Congress, will be held on Monday evening in Windsor Hall, on which occasion the President-Elect, Dr. Walter W. Chipman of Montreal, will be inaugurated and will deliver the annual address.

The annual meeting of the Governors and the Fellows for the election of officers, reception of reports by the officers and standing committees, will be held in Windsor Hall on Thursday afternoon. The fourteenth annual convocation of the College will be held on Friday evening in Windsor Hall, at which time a large class of candidates for Fellowship in the College will be received.

HOSPITAL CONFERENCE

An interesting and instructive program is being prepared for the hospital conference to be held on the first two days of the Congress. Papers and discussions to be presented at this

conference will deal with the various aspects of hospital work as related to the hospital standardization program of the College and will be of particular interest to surgeons, hospital trustees, executives, and personnel generally.

A hospital information and service bureau will be maintained throughout the session to give assistance to any hospital in the solution of its problems. A general invitation is extended to hospital trustees, members of the medical and surgical staffs, hospital personnel generally, and others interested in the hospital field to attend the conference.

HEADQUARTERS AND HOTELS

General headquarters for the Congress will be established at the Windsor Hotel on Dominion Square, where the Windsor Hall, Rose, Blue and Oak rooms, and other large rooms and foyers located on the ground floor have been reserved for the exclusive use of the Congress. The Windsor Hotel is now under the same management as the Waldorf-Astoria in New York, the Bellevue-Stratford in Philadelphia and the New Willard in Washington. In recent years more than a million dollars has been expended in remodeling and enlarging the hotel.

Through the co-operation of the Montreal hotels we are assured of ample, comfortable accommodations for more than 3,000 people. The hotel situation in Montreal has been greatly improved in recent years by the erection of a new hotel—the Mount Royal—located on Peel Street, two blocks north of the Windsor Hotel, with more than 1,200 rooms. The Queen's Hotel near the Bonaventure Station, two blocks from the Windsor, has been remodeled within the year and a new section added that doubles its capacity. In addition rooms have been reserved at the Ritz-Carlton, located at the corner of Mountain and Sherbrooke Streets, four blocks from the Windsor Hotel, at the Corona on Guy Street, and at the Place Viger—all within short walking distance of headquarters except the latter.

An application for reduced fares on account of the meeting in Montreal is pending with the railways of the United States and Canada, and it is practically assured that a rate of one and one-half the regular one way fare on the certificate plan will be authorized for this meeting.

LIMITED ATTENDANCE

Attendance at the Montreal session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance. When the limit of attendance has been reached through such advance registration, no further applications will be accepted.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets, which plan has proved an efficient means for providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room assigned to that clinic.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meetings.

PRELIMINARY CLINICAL PROGRAM

ROYAL VICTORIA HOSPITAL

Tuesday

E. W. ARCHIBALD and staff—9. General surgical clinic.
D. W. MACKENZIE and staff—9. Urological clinic, operations and demonstration of cases.

Wednesday

C. B. KEENAN and staff—9. General surgical clinic.
W. G. TURNER and W. J. PATTERSON—9. Orthopedic clinic, operations and demonstration of cases.

Thursday

F. A. C. SCRIMGER and staff—9. General surgical clinic.
D. W. MACKENZIE and staff—9. Urological clinic, operations and demonstration of cases.

Friday

F. C. MCKENTY and staff—9. General surgical clinic.
W. G. TURNER and W. J. PATTERSON—9. Orthopedic clinic, operations and demonstration of cases.

MONTREAL MATERNITY PAVILION

Tuesday

W. W. CHIPMAN and H. M. LITTLE—9. Gynecological and obstetrical clinic, operations and demonstration of cases.

Wednesday

H. C. BURGESS and J. R. FRASER—9. Gynecological and obstetrical clinic, operations and demonstration of cases.

Thursday

J. R. GOODALL and J. W. DUNCAN—9. Gynecological and obstetrical clinic, operations and demonstration of cases.

Friday

W. W. CHIPMAN and W. A. G. BAULD—9. Gynecological and obstetrical clinic, operations and demonstration of cases.

PATHOLOGICAL INSTITUTE

Wednesday

E. H. MASON—9. Pre-operative preparation of the diabetic patient with discussion of so-called "diabetic gangrene."
J. C. MEAKINS—9. Medical indications for splenectomy. Respiratory abnormalities in regard to the operative risk.
D. S. Lewis—9. Relation of hypertension to surgical risk.
C. F. MOFFATT—9. Relation of cardiac disease to surgical operative risk.

Thursday

DAVID BALLON—9. The bronchoscopic injection of lipiodol as an aid to X-ray diagnosis of pulmonary lesions. Combined bronchoscopic and X-ray demonstration.
A. H. PIRIE—9. Demonstration of lungs injected with lipiodol in bronchiectasis and other diseases. Normal abnormalities of bones.
E. C. BROOKS—9. Report on 100 cases in which tetraiodophenolphthalein was given by mouth, with operative and other findings.

Friday

E. W. ARCHIBALD, F. A. C. SCRIMGER, D. ROSS, GAVIN MILLER, JOHN ARMOUR—9. Experimental surgery.

MONTREAL GENERAL HOSPITAL

Tuesday

H. M. LITTLE—9. Operations: Ectopic gestation, pelvic inflammations.
F. J. TEES—9. Demonstration: Injury to elbow with late ulnar nerve lesion (5 cases).
E. M. EBERTS—10. Demonstration: Unusual types of thyroid disease; two cases of acute traumatic tension pneumothorax.
F. J. TEES and F. B. GURD—10. Fracture clinic.
A. T. BAZIN—10:30. Operations: Gall-bladder disease, carcinoma of rectum.
L. J. RHEA and associates—10:30. Clinical pathological conference.
J. G. W. JOHNSON—11. Cranial injuries.
J. A. NUTTER—2. Orthopedic clinic, operations for paralytic deformities.
F. J. TEES and F. B. GURD—2. Fracture clinic.
L. H. MCKIM—3. Operative treatment of infections and compound injuries of hand and upper extremity.

Wednesday

F. S. PATCH and R. E. POWELL—9. Operations: Prostatectomy, nephrectomy.
F. J. TEES—9. Demonstration: Fractures of ankle and wrist.
A. T. BAZIN—10. Demonstration: Suppurative joint lesions.
F. J. TEES and F. B. GURD—10. Fracture clinic.
E. M. EBERTS—10:30. Operations: Radical cure of inguinal hernia by infolding muscular stitch, under local anæsthæsia; excision of cæcum for carcinoma.
L. J. RHEA and associates—10:30. Clinical pathological conference.
C. K. P. HENRY—11. Demonstration: End-results of splenectomy in pernicious anæmia.
J. A. NUTTER—2. Orthopedic clinic, operations for congenital deformities.
F. J. TEES and F. B. GURD—2. Fracture clinic.
W. L. BARLOW—3. Operations: Excision of tongue for carcinoma.

Thursday

H. M. LITTLE—9. Gynecological operations for repair of birth injuries.
F. B. GURD—9. Demonstration: Fractures of femur and patella.
L. H. MCKIM—10. Demonstration: Wound infection in appendicitis.
F. J. TEES and F. B. GURD—10. Fracture clinic.
A. T. BAZIN—10:30. Operations: Radical cure of hernia by fascial graft; carcinoma of colon.
L. J. RHEA and associates—10:30. Clinical pathological conference.
J. A. NUTTER—11. Demonstration: Backache, sciatica, sacro-iliac and lumbosacral lesions and spondylolisthesis.

Friday

F. S. PATCH and R. E. POWELL—9. Urological operations.
A. T. BAZIN—9. Demonstration: Bone tumors.
F. J. TEES and F. B. GURD—10. Fracture clinic.
E. M. EBERTS—10:30. Operations: Thyroidectomies.
L. J. RHEA and associates—10:30. Clinical pathological conference.

WESTERN DIVISION

F. B. GURD and associates—9, daily. General surgical and gynecological operative clinics.
F. B. GURD and associates—2, daily. Demonstrations of end-results in fractures of the ankle, tibia and fibula, femur, humerus, etc.

MISERICORDIA HOSPITAL

STEPHEN LANGEVIN, E. ETHIER, D. MASSON, A. RICARD, H. SANCHE, P. GAUTHIER, H. LEBEL and DR. JUTRAS—daily. Obstetrical clinics, operations and demonstration of cases; control of eclampsia convulsions by intravenous injection of "somnifene"; pernicious anæmia and transfusion; pernicious vomiting and blood group; Hirudo medicinalis (leeches) in femoral thrombophlebitis; how to treat the child in breech extraction; white asphyxia and cerebral injury.

SAINT JUSTINE HOSPITAL

DRS. FARRON, CRÉPAULT, DUBÉ, and RIVARD—daily. Operative clinics and demonstration of end-results, general surgery in children; harelip, undescended testicle, prolapse of rectum, congenital hernia, spina bifida, curvature of the spine and Pott's disease.
A. COMTOIS—daily. X-ray demonstrations.

HOTEL DIEU

EUGENE ST. JACQUES and associates—9, daily. Operative clinics: General surgical, gynecological, urological and orthopedic cases.
EUGENE ST. JACQUES and associates—2, daily. Demonstrations: Clinical aspects of splenomegaly, tuberculosis of the intestinal tract, arthritis deformans, treatment of fracture of the patella by the Delbet method, heliotherapy as an adjuvant in the treatment of osteo-arthritis as practiced by Leysin and Davos.
LEO PARIZEAU—daily. X-ray demonstrations.

CHILDREN'S MEMORIAL HOSPITAL

A. MACKENZIE FORBES and staff—10, daily. Operations: Harelip, cleft palate, hernia, tendon transplantation. Demonstrations: Reduction of congenital dislocation of the hip, correction of deformities due to club feet, correction of deformities due to rickets, sequestrotomy. Application of extensions in fractures and tuberculosis of the hip. Demonstration of routine examination of children suffering from tuberculosis of bones and deformities following acute anterior poliomyelitis. Osteomyelitis (lantern slide demonstration). Scoliosis and its treatment. Preparation of plaster bandages and demonstration of their proper application.

NOTRE DAME HOSPITAL

L. DEL. HARWOOD, O. F. MERCIER and associates—daily. Operations and demonstration of cases, general surgery, gynecology, urology, etc.